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ADVERTISING CONTENTS

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ON THE COVER

THROUGH the years Niagara has lost none of its charm and is still rated as one of Nature's greatest shows. Once more or less reserved for honeymooners, it now attracts whole families. Our cover picture shows the American Falls and Rainbow Bridge as seen from Goat Island. Prospect Point, a section of which collapsed on July 28, is in the central part of the picture, where people are viewing the spectacle.

IN THIS ISSUE

OUR leading article is a bizarre tale of a transplanted Spanish monastery which offers further evidence that truth is sometimes stranger than fiction.

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FOR almost 50 years Philip Brasher has been trying in vain to convince the world that puny bubbles of air can knock down monstrous waves. His novel breakwater scheme has had millions of dollars worth of free publicity but has never repaid its inventor his development costs. Wherever it has been used it has not failed, yet it is still looked upon with skepticism. Its latest successful but temporary application was in England. Page 221.

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BY THE time these words are read, iron ore will be moving to market from the remote Quebec-Labrador deposits. The 1954 goal is to ship 1½ million tons before winter closes in. The mines are working two 10-hour daily shifts, and the screening plants, 362-mile railroad line to Seven Islands, and the ship-loading plant there are all undergoing tune-up for the years of strenuous service ahead. Page 223.

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THANKS to continual advances in surgical skill and equipment you are much safer in an operating room than ever before. Compressed air contributes to the working of one of the newest safeguards for patients—an instrument that automatically registers and records blood pressure, pulse and respiration. Page 231.

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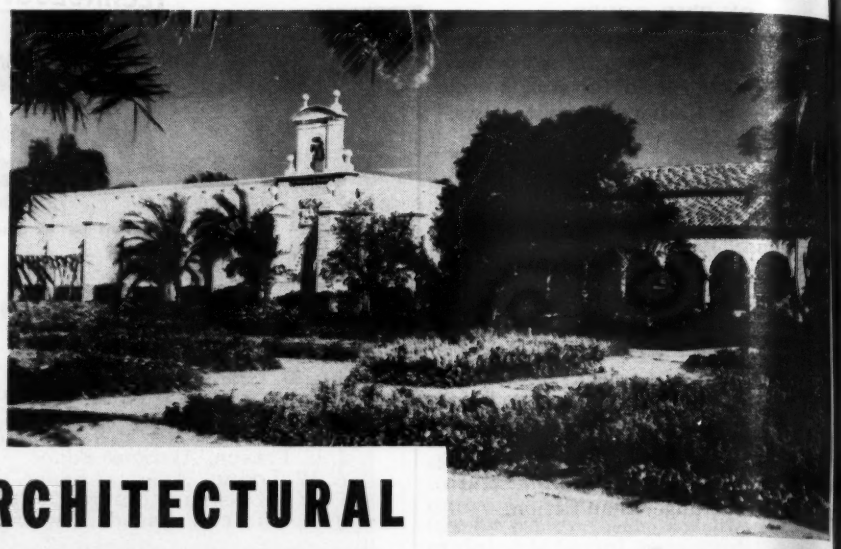
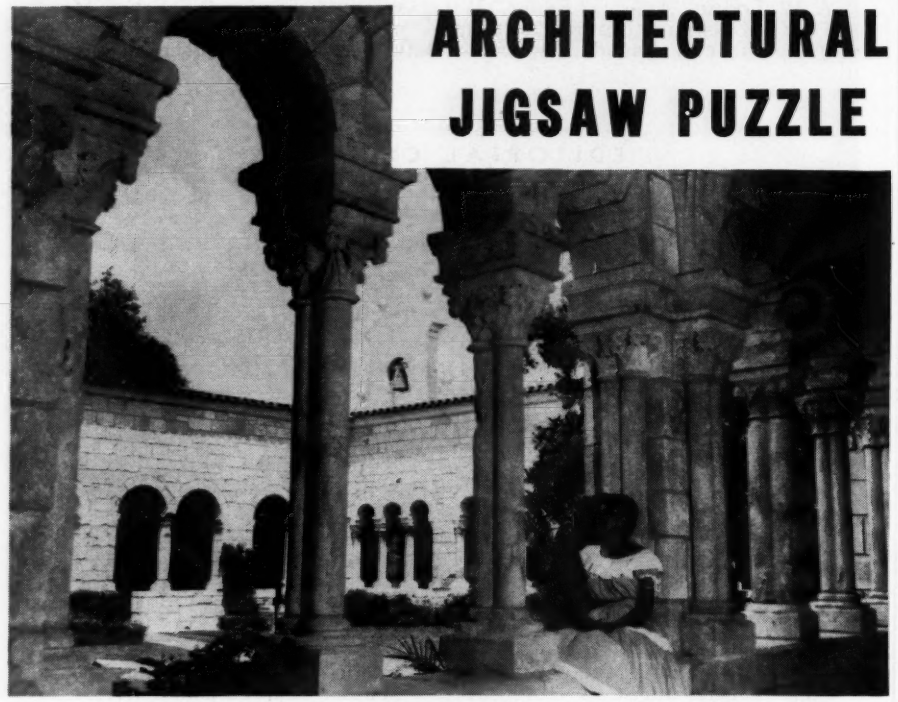
AN ENGLISH reader takes us to task for stating in our May issue that an 8-mile tunnel included in Canada's Bersimis Project is exceeded in length among power tunnels only by the bore at Kemano, in British Columbia. Our article apparently should have limited the comparison to Canadian examples, for our correspondent points out that a 15-mile, 15-foot-diameter bore was driven in 1926 for the British Aluminum Company's Lochaber waterpower scheme.

Reconstructing twelfth-century Spanish monastery becomes world's greatest



ARCHITECTURAL JIGSAW PUZZLE



RESTORATION

The reconstructed monastery, top, at North Miami, Fla., is surrounded by formal gardens of the Old World type. They contain more than 10,000 blooming plants and a large collection of rare tropical trees and shrubs. The quadrangular cloister walks, lower picture, have been rebuilt exactly as they were during the centuries when trod by praying monks. The capitals of the columns in the foreground were carved by captive Moors and no two of them are alike.

JACK BONDURANT

JUST north of Miami, Fla., the most fantastic architectural jigsaw puzzle in history finally stands pieced together. It is the actual 813-year-old Monastery of St. Bernard of Sacramenia, assembled, stone by stone, exactly as it was first reared in ancient Spain back in the year 1141.

Completion of the work climaxed a bewildering train of events. The story is a bizarre one of plans that went awry and created a gigantic omelet of stone that had to be unscrambled. It contained more than 35,000 pieces that weighed from 100 pounds to more than a ton each. Sorting them and fitting them together in their original positions required nineteen months of tantalizing toil and cost nearly $1,500,000.

Rich and powerful Alphonso VII, king of old Castile, built the cloister for the ascetic Cistercian monks in a lonely valley near the village of Sacramenia. A prankish fate, aided by the insatiable appetite William Randolph Hearst, the late publishing tycoon, had for great art treasures, turned the job of reërecting the dismantled structure into a gargantuan jigsaw puzzle. Its solution fell to two Cincinnati, Ohio, businessmen, E. Raymond Moss and William S. Edgemon.

The monastery was one of $50 million worth of treasures Hearst collected from the four corners of the earth for his fabulous estate at San Simeon, Calif. His art agent found it in the 1920's in its isolated hiding place, overlooked by the rest of the world. In 1835 it had been confiscated by the Spanish Government along with all other cloisters in the country. The monks and lay brothers who lived there were banished, and the centuries-long existence of the edifice as a monastery ended.

The Spanish Government, less interested in the structure as a historic link with the Middle Ages than as a source of revenue, sold it to a farmer. The latter walled up the graceful columned arches of the cloister walk and stored grain in the enclosed spaces under the Gothic ceilings. The magnificent chapter house became a storage room for farm tools, and the cathedral-like refectory was converted into a stable, a haymow and a shelter for plows and wagons. Other buildings except the church in the little monastic community and the outer wall that surrounded them either fell into ruin or were torn down and the stones used to put up new structures. Only the fact that the cloister walk, the chapter house and the refectory served useful purposes saved them from the same treatment.

That was how Hearst's agent found the monastery. Nevertheless, he recognized it to be not only one of the finest examples of Romanesque and early Gothic architecture in existence but also one of the world's great works of art. For a sum said to have amounted to $500,000 it was bought by Hearst to be taken apart and sent to San Simeon. Architects, who were detailed to draw plans to serve as a guide in reconstructing the building, assigned a key number to each of the thousands of stones and indicated just where it belonged. But here fate played its first trick. So complex, so involved was their system of numbering that it was well-nigh undecipherable when attempts were made to use it 25 years later.

To dismantle the monastery, Hearst's

gent brought stonemasons and carpenters from as far away as Madrid. Masons took it apart stone by stone and painted a number on every one. Carpenters made thousands of crates to pack them in, and each stone was bedded in a nest of hay which appeared to be innocent but was actually the cause of fate's second prank.

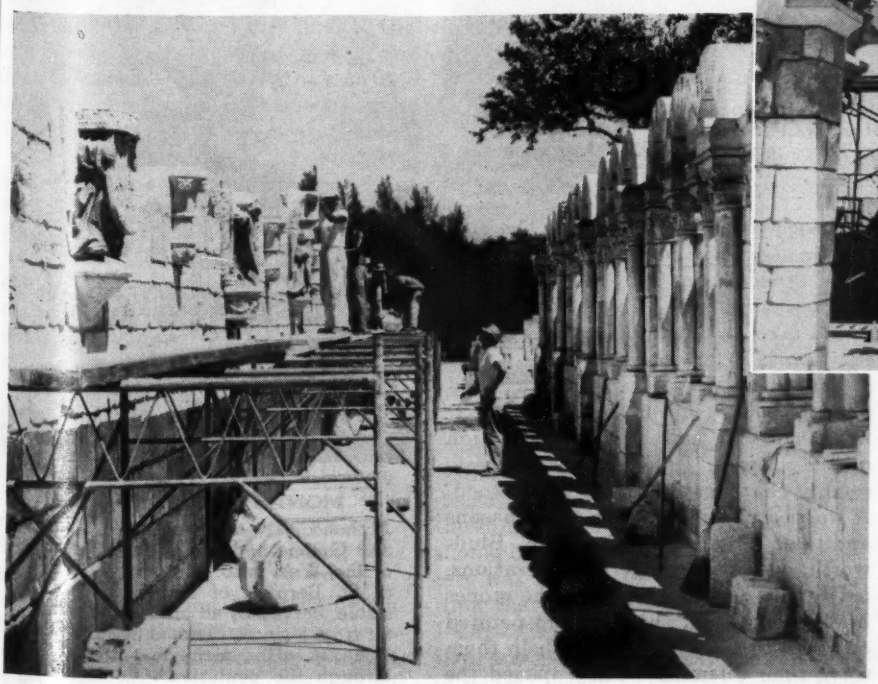
As many as 10,751 boxes were needed to crate the structure for shipment to New York, 4000 miles away. But upon their arrival the cases were quarantined; the packing material had been mown in a section of Spain where there was an outbreak of highly contagious hoof-and-mouth disease. Hearst was ordered to open every crate, burn the contaminated hay and replace it with excelsior. This took three years and cost him nearly $75,000. In repacking, mischievous fate played its final trick. Workmen put the stones in whatever boxes were closest at hand, without regard to the corresponding, identifying numbers painted on both stones and crates.

Then the great depression hit. Hearst's monastery, nailed in its many boxes and piled high on three floors of a warehouse in The Bronx, was left to gather dust and storage bills. At one time the fortunes and misfortunes of the venture had been chronicled in columns of type. As the years slipped by, they attracted no more than an occasional and obscure paragraph or two. But one of these items came to the attention of Moss and Edgemon, the two men who were eventually to resurrect the cloister from its limbo of dusty crates.

Long-time partners in the building field and in the development of real

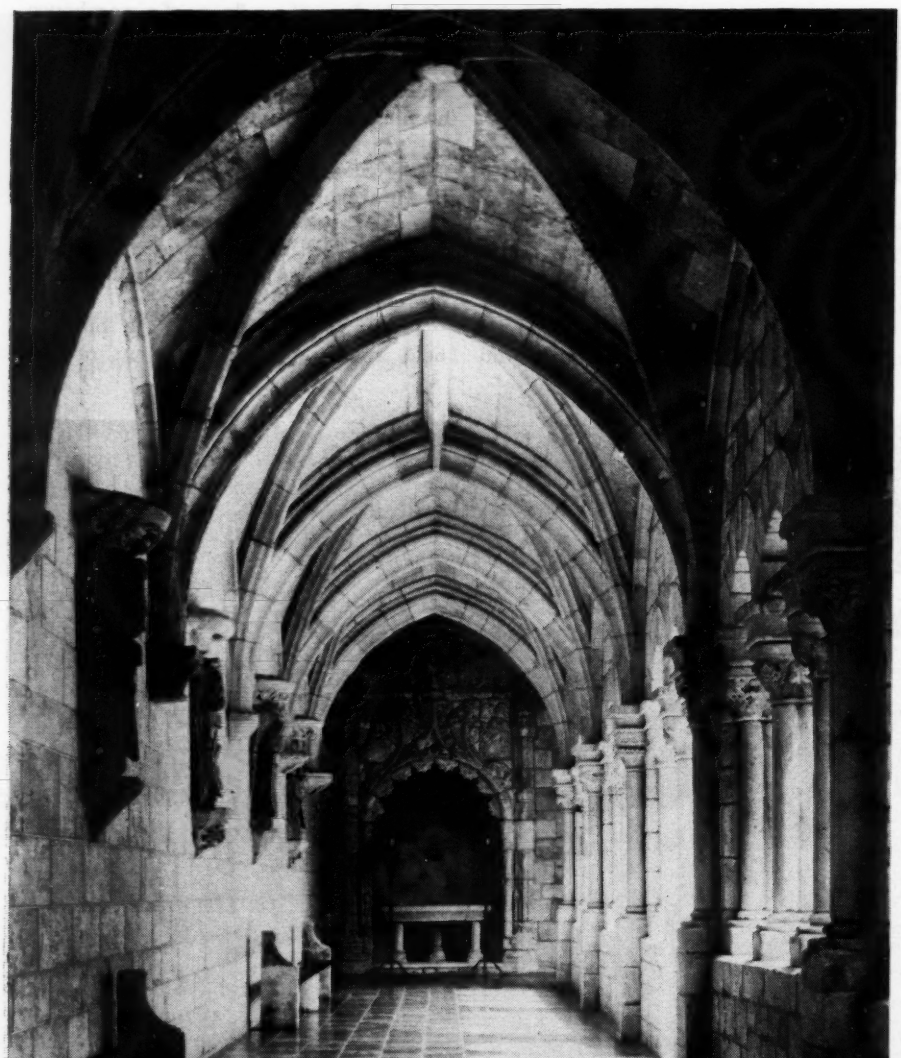
HODGEPODGE OF STONE

It took 23 men six months to open the 10,751 boxes of stone and sort their contents as best they could by size, shape and related numbers. The stones were spread out over ten acres.



SOLVING THE RIDDLE

Expert masons determined by measurement and trial where each stone was to go. A misfit had to be removed and the search continued until the right block was found. The view at the left shows the north cloister walk during reconstruction (see picture next page). Months were required to reassemble the 93 arches of interlocking stone in the chapter house (above). Photographs taken in Spain before the dismantling were of much help in this work.



GOTHIC ALTAR FACADE

The facade at the end of the north cloister walk is made up of more than 900 pieces of intricately carved Caen stone. In the left wall are armorial corbels representing noble families of the Middle Ages. They are valued at $12,000 apiece.

estate, they became intrigued with the idea of restoring the monastery to its original state. They attempted to buy it from Hearst. That was ten years ago. The publisher said he would never sell it — as long as he lived. In those last words, Moss and Edgemon believed they read a special significance. In 1951 Hearst died.

Through their New York attorney, Carrol A. Muccia, who was close to the Hearst estate trustees, the partners purchased the cloister. They chartered a freighter and shipped the odd cargo to Port Everglades, Fla. That cost them $60,000. A fleet of trucks shuttled back and forth day and night moving the boxes to the site Moss and Edgemon had selected north of Miami. The new owners assembled a crew of eight of the finest stonemasons they could find for the rebuilding job. They estimated it would take six to eight months and cost between $150,000 and $200,000.

Came the day for work to start and with it the first intimation to the partners that they had a baffling situation on their hands. The complicated reassembly charts could not be understood. A worried conference with their masons and their Florida associate, E. K. Bludworth, who was to supervise operations, led to the decision to check the stones in the crates and the numbers painted on them to see if that would help them solve their dilemma. They opened the first box, the one that was supposed to contain the stones that would be the starting point for the whole assembly. They were not the right ones!

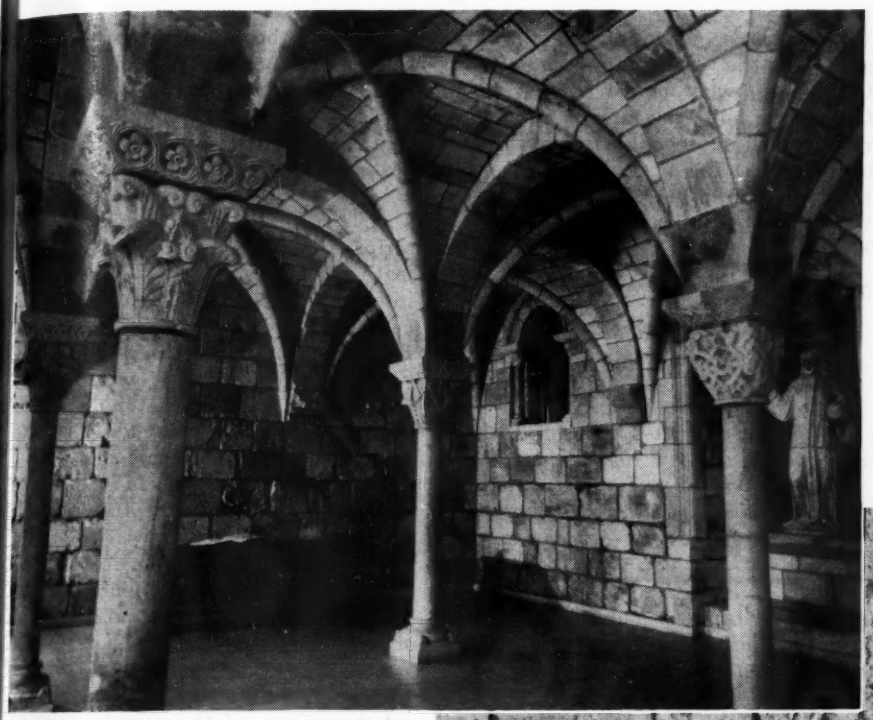
More crates were ripped open, and more and more! But each one only added to the confusion. In the New York episode 25 years earlier the workmen had hopelessly jumbled the original careful packing system. Now Moss and Edgemon realized that with the stones they had acquired a most bewildering riddle.

Twenty-three men toiled three months doing nothing but opening and emptying boxes. They spent the next three months sorting the stones according to size and shape and, insofar as possible, to related key numbers. The stones covered ten acres. By chance, Hearst had had two dozen photographs taken of the monastery in Spain. These pictures showed practically all the details of the separate parts of the building as it stood when he bought it.

With photographs in one hand, complex Spanish plans in the other and an expert knowledge of masonry in their heads, the eight masons and Bludworth began a needle-in-the-haystack hunt for

MONASTERY FOUNDER

Alphonso VII, King of Leon, Castile and Galicia and Holy Roman Emperor of the West who built the Monastery of St. Bernard of Sacramenia. The statue, carved by an unidentified sculptor from a single block of Spanish limestone, is in the niche that it occupied through the centuries.



DETAILS OF CHAPTER HOUSE

A marble statue of Christ stands on the altar (left) in the chamber where once the novices were instructed by the abbot of the monastery. The four columns that divide the bays of the vaulted ceiling represent the four cardinal virtues—wisdom, courage, temperance and justice. Against the left wall is a table bearing a fourteenth-century parchment hymnarium (below) that was written and illuminated by hand. It is an item in the collection of medieval art treasures on display in the monastery. In the stone just left of the book is seen a carving that resembles the letter "M" and was put there by the mason who cut and set it originally. Every stone has such an identifying mark, and the number of the different ones found indicates that 94 masons helped to build the cloister.

the right stones. Most of them had to be laid by a method of "dry assembly" to find their exact locations. First they were fitted together loosely on a large concrete platform, checked carefully against the photographs and diagrams and, if they belonged together, moved as a unit to be cemented into their old places.

If a selected stone didn't fit in the dry assembly it had to be lifted out by main strength or mobile derrick, trundled away and the search resumed. Sometimes an unusual shape or a related key number in a series would lead to the sought-after stone in a matter of minutes. Other times hours and even days were spent looking for it.

Week by week, month by month, the slow, tedious work went on. Costs doubled, trebled, quadrupled. But stone by stone, column by column, arch by arch, the old monastery gradually took form: first the cloister walk around the patio, next the chapter house, and finally the big refectory. At last the vexing jigsaw puzzle had been solved!

The stone in the altar facade, built of 900 pieces many intricately carved, differs from that in the remainder of the monastery and has been identified as a well-known limestone from the Caen district in France. Art experts, sculptors and masons who have examined it agree that it dates from the fourteenth century and was obviously not a part of the original structure. A figure carved in a prominent position indicates that the facade was added as a memorial to a priest or abbot.

With that exception, the building material is Spanish limestone. It has withstood weathering through the centuries remarkably well, that in the interior walls naturally showing the least erosion. Surfaces are comparatively rough, no doubt because the stone was worked by hand with rather crude tools. Two decorative plaques that were badly deteriorated were moved from exterior to interior walls to save them from further damage.

Through the years, some of the walls were covered with stucco or hundreds, possibly thousands, of coats of whitewash. This accumulation was to have been chipped away when the abbey was dismantled, but much of it still clung to the stones when they were unpacked. It should be borne in mind that the monastery was continually occupied by monks from the time it was constructed until 1835. They kept it in excellent condition, and evidence of repairs can be seen in several places. The farm family that used the building from 1835 until Mr. Hearst purchased it also apparently took reasonably good care of it.

Nevertheless, reconstruction involved the use of some modern materials. The old roof tiles were in such bad shape that they had to be discarded for new ones. The original floors, composed of rubble, had been compacted by the feet of monks until they were undulating, leaving marks on some of the lower wall stones that are still visible. Because it was impracticable to remove, pack and ship the rubble, new floors of square tiles were laid.

Both to protect the transplanted structure and to conform to Florida's rigid hurricane building code, the exterior of the monastery has been sheathed with modern concrete blocks reinforced with steel. Inside this shell, the building

stands as it was first erected. The cloister walks, which form a quadrangle about 80 feet square, are 12 feet wide under 20-foot ceilings. The refectory is 65x25 feet in size and has a maximum height of 33 feet at the peak of the vaulted arches. The chapter house measures approximately 27x29 feet.

The single bell in the tower is a replacement, but has a history that rivals in interest that of the structure in which it hangs. When Mr. Hearst bought his prize, there was no bell and no record of what had happened to it. When reconstruction got underway, search for an appropriate one was instituted. Word of it reached the owner of a large hotel in the Miami area who is a collector of bells and he let it be known that there was supposed to be one in a Miami junk yard. Investigation verified the report, and the bell was purchased. Subsequently, its background story was pieced together but for some missing links.

The 500-pound bell, which is of bronze tempered with silver, was cast in France in 1773—the date and a crucifix being embossed on the lip. It hung in the tower of a small French church, where it became noted for the clarity and deep vibrance of its tone. In 1805 it was sent as a gift from France to Haiti to mark the first anniversary of that country's independence under the notorious Jean Jacques Dessalines who, before his assassination, was to bathe the island in the blood of massacred white planters and their families.

Dessalines's general-in-chief of the army was the "Black Emperor," Henri Christophe, who named himself king. Christophe built the famous Citadel, a massive and impregnable fortress on top of the highest and most inaccessible peak in Haiti, and either took or was given the bell to hang there. But Christophe killed himself with a silver bullet when his people turned against him for his cruelty. The bell is believed to have been looted from the fortress, but where it was for about 140 years and how it got into the Miami junk yard are still mysteries.

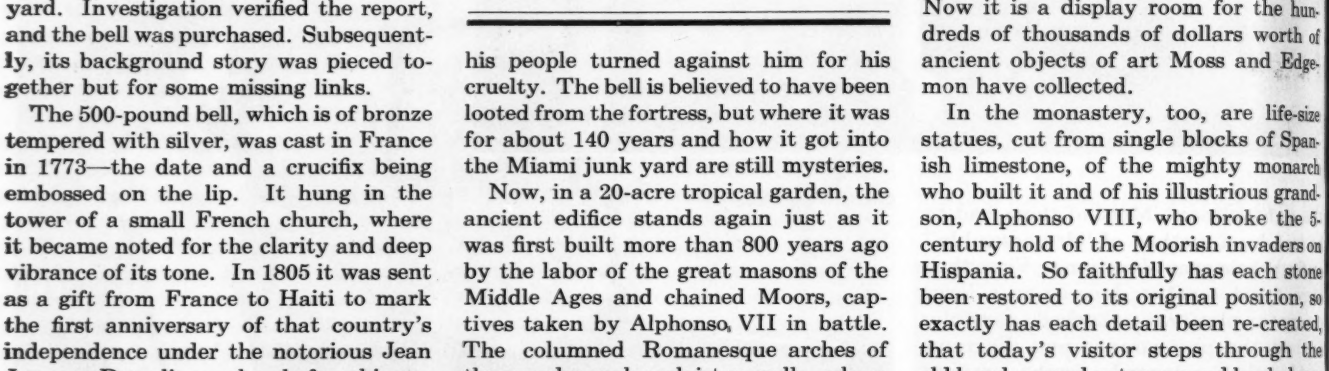
A good barometer of a country's standard of living is its use of oil per capita. In the United States, oil consumption per capita ran over 735 gallons last year. In France, the per capita use was 104 gallons. Income figures run a close parallel, for the average American's income is three times that of a Frenchman.

Now, in a 20-acre tropical garden, the ancient edifice stands again just as it was first built more than 800 years ago by the labor of the great masons of the Middle Ages and chained Moors, captives taken by Alphonso VII in battle. The columned Romanesque arches of the quadrangular cloister walk, where tonsured monks strolled while they murmured endless prayers, enclose the garden bright with flowers.

Flanking the east walk is the chapter house. From an altar opposite the doorway, the same impressive statue of Christ looks down as it did for eight centuries on the stone-walled room where coarse-garbed novices listened to their abbot's priestly instructions and where scribes spent lifetimes copying delicate script onto parchment pages in huge, leather-bound volumes. Overhead, 93 interlocking Gothic arches form a vaulted ceiling of incredible beauty that seems to float in air on hand-chiseled stone ribs.

In the refectory, the towering ceiling rests on six triple-ring stone arches 31 feet high. Each arch is made of 115 perfectly fitting stones having an aggregate weight of 12 tons. It was in the refectory that the monks and lay brothers ate their meals from intricately carved long tables. Now it is a display room for the hundreds of thousands of dollars worth of ancient objects of art Moss and Edgemon have collected.

In the monastery, too, are life-size statues, cut from single blocks of Spanish limestone, of the mighty monarch who built it and of his illustrious grandson, Alphonso VIII, who broke the 5-century hold of the Moorish invaders on Hispania. So faithfully has each stone been restored to its original position, so exactly has each detail been re-created, that today's visitor steps through the old hand-carved entrance and back down the corridors of time. The modern world seems to vanish — the long-dead twelfth century comes alive again.



TRANSPLANTING NEARLY COMPLETED

An aerial view taken last February when final touches were being given the formal gardens and grading was still in progress. In the background is the monastery with the enclosed cloister walk, approximately 80 feet square, at the left; with the chapter-house roof barely visible beyond it; and with the refectory at the right. The over-all length is about 162 feet. The light-colored patch at the upper-left is made up of stones from the structure that once housed the kitchens, which will be put up before the year is out. At the bottom is the administration building composed throughout of modern materials. A charge is made for entering the grounds.

Strange Case of the Pneumatic Breakwater

Fascinating wave leveler nearing 50th anniversary has never "caught on" despite spotless record

THE pneumatic breakwater was recently in the news again. This simple method of calming heavy seas with nothing more formidable than bubbles of air was put to work temporarily at Dover, England, to enable train ferries plying the storm-whipped straits from France to dock without taking a buffeting while the outer gate of the protective, enclosed basin was being given a periodic overhaul. According to all reports, it performed its mission successfully and without incident, thus adding another chapter to a long story of satisfactory service and increasing the wonderment and mystery as to why this fascinating invention has not been utilized more extensively.

The pneumatic breakwater is now nearly half a century old and has never failed to live up to all the claims made for it by its inventor, Philip Brasher. Yet, it has been used only sparingly and intermittently and has been viewed with skepticism almost every time he has endeavored to have it adopted for various marine services. On one occasion some years ago he even offered to put in a $60,000 system to prevent wave erosion at one of the swank New Jersey beach resorts, asking for not one cent of payment unless it did everything he said it would do. Inexplicably, the proposition was rejected.

Efforts made through the years to interest our Navy Department in the device have been unavailing. Apparently the principle on which it is based sounds too simple for it to work. Meanwhile Mr. Brasher hasn't lost any of his confidence in his brainchild despite the fact that he has spent a small fortune in fruitless attempts to promote its use.

The long struggle has not been wholly without its compensations, however. For one thing, Mr. Brasher got a college education as a result of the breakwater scheme. Realizing at the outset that he needed technical knowledge to develop his idea, he worked his way through Princeton University and even found time to play football for four years. He played so well that he was asked later to come back as head coach and he filled that job for several years. In his best season, 1922, the Nassau Tigers not only won the Ivy League championship but also unexpectedly beat the University of Chicago team, which was rated as one of the nation's "powerhouses." In consequence, Mr. Brasher is probably the only possessor of two of Princeton's miniature gold football watch-charm trophies—one a reward for his playing and the other for his coaching.

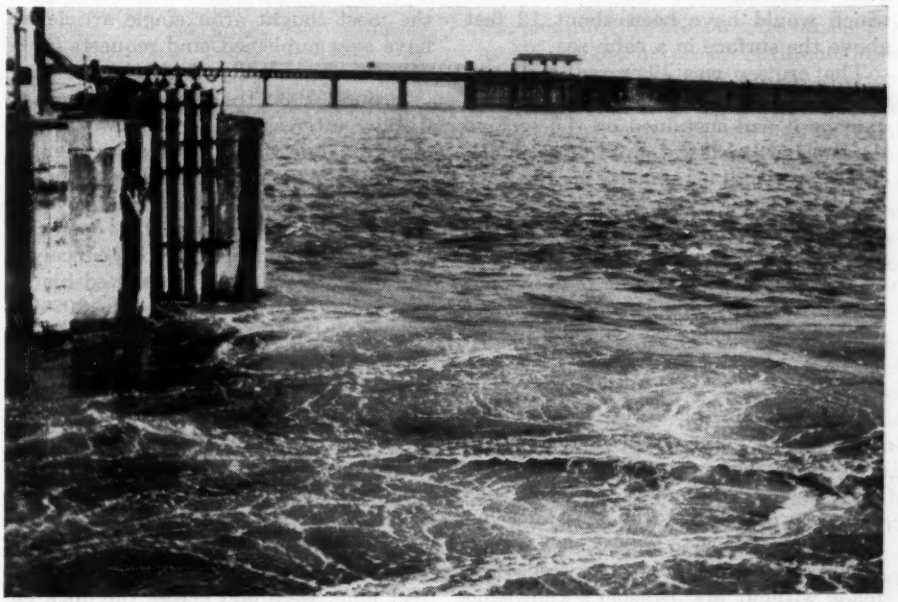
The breakwater scheme was conceived somewhat by chance. Reared in the East, Mr. Brasher spent six years as a young man punching cows in Colorado and returned to New York in 1900 with nothing but the clothes on his back. He found employment at nearby Brighton Beach, where the Parkway Amusement Company maintained bathhouses for its patrons. In an effort to control or prevent erosion of the waterfront property by wave action, the owners of the business built a $125,000 jetty extending 400 feet out from the shore. Three months later a storm tore out $40,000 worth of it in three hours.

That started young Brasher to thinking that there must be some better method of combating the force of the sea. To get a good base to build on, he began studying wave action. He learned that a comber exerts its major damaging effect as it is curling to break. At that instant it is undergoing a change from mere oscillation of its component particles to sustained horizontal travel. When it breaks, the momentum of tons and tons of water, moving laterally and then falling from whatever the crest height may be, is practically irresistible and will in time beat down just about anything rigid that man can put in in its path.

"I visualized the problem as similar to that of stopping a ball carrier in a football game," Mr. Brasher explained recently. "You can do it by getting in his way, but a far better and easier method is to grab him by an ankle and upset him. I decided that there must be some way of getting at a wave's ankle and set out to find it."

Advancing waves extend far below the surface and there they have only lateral movement. They break when they encounter a shoal or run up on a shallow beach—in other words, when something takes the feet out from under them. Young Brasher reasoned that a vertical force was needed to lessen the combers' horizontal drive, and out of a clear sky conceived the notion of creating it by simply stringing perforated pipes along the sea bottom and releasing air that would bubble through the water to the surface. If the scheme worked, he knew that he could flatten out waves whenever he chose and curb their power before they could wreak havoc.

Finding himself unable to work out the theory involved, Mr. Brasher enrolled in Princeton. Upon learning why he was there, the dean of engineering became more enthusiastic about the breakwater idea than his pupil. He had tanks set up and even contrived to obtain the use of the university's swimming pool for the experiments. Miniature waves were artificially created, and it was demonstrated that an air screen would actually lower their intensity. However, after numerous unsuccessful attempts to devise a formula for determining how much air would be needed to trip combers of varying sizes, it was decided that the information could be gained only by tests with real waves.



British Transport Commission Photo

IN ACTION AT DOVER, ENGLAND

Air rising from submerged piping at the entrance to the ferry slip produced the "slick" shown, which is similar to that caused by spreading oil. This installation recently served successfully for four months while repairs were being made to the outer of the two gates of the enclosed docking basin that protects boats at pierside from wave action.

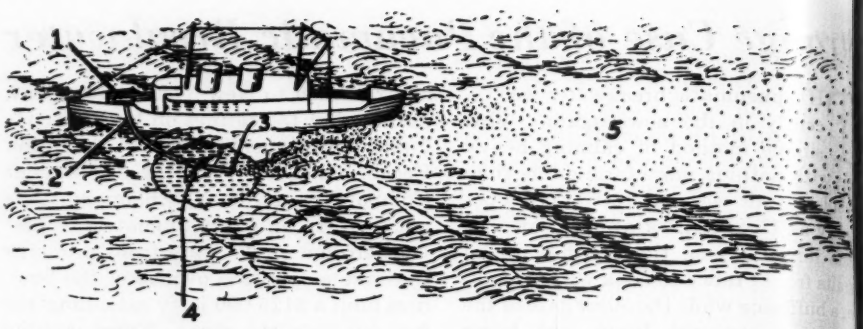
Mr. Brasher had no chance to conduct such tests until after he had been graduated and got a job with the Morse Dry Dock & Repair Company in New York Harbor. There he strung a perforated pipe line along the bottom of the bay and at odd times was able to use the compressed-air distribution system for making his observations. He learned a lot about what diameter of pipe would best serve his purpose, what size and spacing of air outlet holes would be most efficient, and how sticky mud could block the openings.

In 1908, during an exhibition of machine tools on the Million Dollar Pier in Atlantic City, N.J., he got permission to hook onto the air lines. He ran piping to the end of the pier, where he dropped 100 feet of perforated 3-inch tubing. This setup was operated for about three weeks. Later in the same year he arranged to conduct some experiments at Crotch Island, Maine, where a quarry located close to the shore had an air-compressor plant with a capacity of 8000 cfm. In none of these cases was there anything that had to be protected, and the equipment and the physical conditions had to be taken as they were.

In the midst of the Maine tests, Mr. Brasher received a call for help from John Arbuckle, then the nation's leading coffee packer, who had undertaken to refloat the U.S. Cruiser *Yankee* which was hung up on Hen and Chickens Reef in Buzzards Bay, Mass. The vessel had three compressors aboard, and Brasher's job was to protect the foundered ship from the pounding waves until it could be freed from the rocks. He succeeded in subduing 20-foot combers that had been breaking over the craft's deck, which would have been about 12 feet above the surface in a calm sea.

The cruiser was liberated but, unfortunately, sank twelve hours later from damage it had sustained on the reef, so the Brasher Breakwater didn't get much credit or favorable publicity for the work it had done. Mr. Brasher was on the vessel when it went down at 4 A.M. and was lucky to survive. He lost everything he had with him, including photographs he had taken to show the calming effect of his air screen.

Since then the system has been successfully applied about thirty times in various parts of the world, but never on a permanent basis. Its longest trial was on the Pacific Coast where it served to protect an oil company's loading pier that was originally 4100 feet long but had been reduced to 2100 feet by storm action. That installation, which was made without Mr. Brasher's knowledge or consent, was used intermittently and apparently worked satisfactorily for ten years or so. It was discontinued when the inventor brought suit for infringement of patents.



HOW SEAS COULD BE CALMED FOR PLANES

The sketch illustrates how the compressed-air breakwater could be applied to provide a "runway" for seaplanes. It was patented by Philip Brasher during World War II. Air from a compressor, 1, aboard the ship is conveyed through a hose, 2, and discharged 75 to 100 feet underwater at 3. A paravane, 4, keeps the hose submerged and at the desired distance away from the boat. The escaping air would, the inventor claims, create a quiescent area, 5, that could be used by seaplanes to take off and land with safety. This scheme would permit small vessels not equipped with catapults to carry a plane or two, which would be lowered onto or lifted out of the water by a crane. Mr. Brasher contends that a ship moving at a rate of 15 miles per hour could produce a calm stretch of sea from ½ to ¾ mile long and of substantial width. The latter could be increased by using more than one air hose, or air lines could be extended from both sides of the boat.

Another of the many disappointments the breakwater has brought its originator was a futile trip to South Africa in 1924 at the invitation of Premier Jan Christiaan Smuts who thought the wave-calming device could be used to advantage in the harbor at Port Elizabeth. Upon arriving at Capetown with his wife after a long sea voyage, Mr. Brasher found that General Smuts had been suddenly displaced by James B. Hertzog.

The idea of fragile bubbles smashing angry seas appeals to the imagination, and the system has received reams of publicity through the years. The inventor's archives contain articles in 22 languages, including the Japanese. A description of the scheme that appeared in our own magazine in 1921 has been the most sought after single article we have ever published, and requests for it are still occasionally received.

Around 1930 the Russians began to display interest in the breakwater and they are known to have experimented with it a lot and may have even put it into regular service. A year or two ago a leading American weekly magazine credited the Reds with having conceived the idea. Mr. Brasher patented his invention in the United States in 1907 and subsequently in several other countries. He is not covered in England, however, and the installation at the Dover ferry slip previously mentioned was put in by a British firm, Pneumatic Breakwaters, Ltd., the head of which, A.H. Laurie, holds a British patent on the method.

At Dover, where the harbor waters swirl around in great confusion during heavy weather, four parallel air lines, 96 feet long, were laid across the dock entrance in about 40 feet of water. As it was not the intention to use the system for a long time, the piping consisted of available superheater fire tubes from a locomotive. It was 4⅞ inches in diameter and welded into 24-foot lengths flanged for convenient assembly at the site. Holes ⅛ inch in diameter were spaced 3½ inches apart. Air was supplied through a header and manifold by a compressor driven by a French-made kerosene-burning gas turbine. The unit was capable of delivering from 500 to 1800 cfm at 50 psi, this range being accomplished by varying the turbine speed from 26,000 to 35,000 rpm.

The installation worked successfully and without incident during the four months it was in service and was removed when the outer dock gate was restored to duty. The air was turned on 26 times for varying periods, and waves up to 4 feet high outside the breakwater were reduced to 9 inches by the time they reached the inner gate. Pressure was maintained at about 5 pounds above hydrostatic pressure, or about 17 psi.

The best results were reportedly obtained by providing around 20 cfm of air per yard of pipe, or a total of 640 cfm, which is a little higher than the volume Mr. Brasher has usually found it necessary to use, although the quantity depends on the height of the waves. Not more than one of the four pipes laid was required at any time (Mr. Brasher has never specified more than one in any of his installations).

Thus the bubble breakwater has chalked up another effective performance and again upheld the faith of its originator. Whether or not he lives to see it, Mr. Brasher is confident that his plan will some day be widely and regularly applied for such purposes as protecting vulnerable coastal areas from erosion, creating "safe harbors" for ships in trouble at sea, permitting all sorts of marine construction and salvage work to proceed without interruption from the weather, and calming rough water everywhere for the smooth landing and take-off of seaplanes.

IRON ORE FROM LABRADOR

Shipments from fabulous Ungava deposits began the first of August

J. P. SMALLWOOD

CONSTRUCTING MENIHEK DAM

To provide a supply of hydroelectric power for the mines and townsite, Menihek Dam, begun in 1952, was erected 30 miles southwest of Knob Lake with an initial installation of two 6000-hp turbines and space for two more. The concrete dam, pillars for which are shown at the top, is flanked on both sides of the stream by earth dikes and provides a head of about 35 feet. Tracks for the railroad into the mining area are laid on the crest of the structure. Cement and much of the other material required for the dam were flown in. The lower picture shows some of it awaiting transport at an airstrip at Mile 134 along the railway. Included, at the middle right, are two Canadian Ingersoll-Rand 315-cfm air compressors with their wheels removed to facilitate loading.

PART TWO

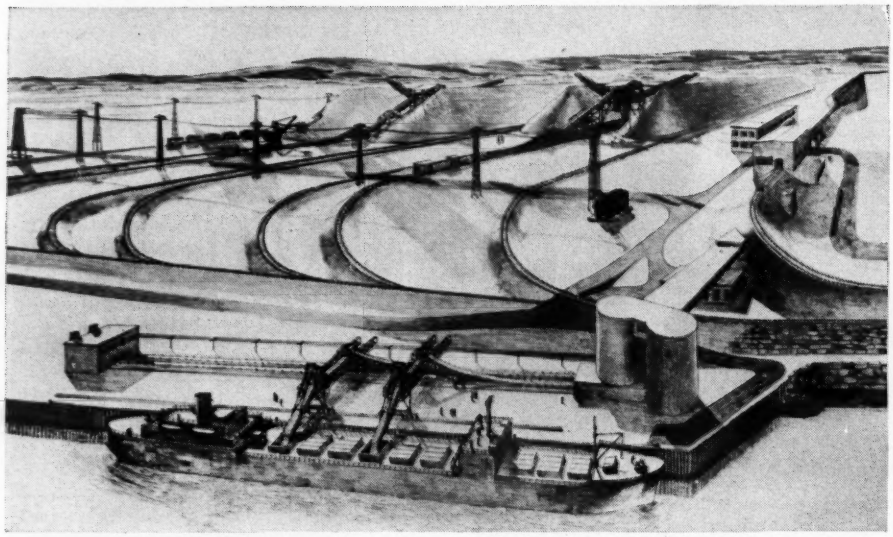
FOR the first few miles out of Seven Islands the terrain is flat and sandy. Then, suddenly, one climbs a mountain and is in rough country. So rough, in fact, as far as Mile 16 that ties and rails had to be laid individually instead of in 39-foot prefabricated sections, a practice which, with the help of other factors like the air lift, made it possible beyond that point to advance at a rate of as much as 2 miles a day. This exceeded the daily pace of 1.3 miles necessary to maintain schedule and to wipe out the seemingly disastrous effects of some bottlenecks that were encountered during the first stages of construction.

One of these slowdowns was below Mile 12 where a 2250-foot tunnel (35,000 cubic yards) had to be excavated and where a dynamite blast collapsed the roof causing the mountain to come down through the hole. Another was just past the tunnel at the turbulent Moisie River where a spring flood washed out a pile trestle and a new start had to be made in bridging the stream.

Today, all this trouble is a thing of the past, for the Moisie is traversed by a single-track structure of continuous truss construction supported by two intermediate bents. It is made up of three main spans 135 feet, 247½ feet and 202½ feet long, respectively, with three 40-foot deck-plate girder spans at the north end. This land of rivers required the building of some seventeen bridges between the Moisie River and Knob Lake. They are mostly of steel and from 40 to 160 feet in length.

With the crossing of the Moisie behind them, the builders faced 5 miles of rugged terrain with deep rock gulleys overlain in spots from Mile 10 to Mile 30 with sticky blue clay. These canyon-like valleys persisted until Elevation 2050 was reached about 150 miles north of Seven Islands. Beyond that point the country is comparatively flat.

Most of the area underlain by iron ore has a characteristic corrugated pattern resulting from alternating northwest-trending ridges 600 to 1000 feet above the level of the surrounding land and numerous linear lakes of varying sizes which are the topographical ex-



ORE-HANDLING FACILITIES AT SEVEN ISLANDS

Weather conditions will normally limit mining to 5½ months, from about May 15 to October 30, and at the start seven trains a day will carry approximately 70,000 long tons (2240 pounds) of ore, or well over 10 million tons during the season. Ships will transport the material from the railroad terminal at Seven Islands during nine months of the year, from about March 1 to late November. In order that they may operate for a longer period than the mines, some ore will have to be stockpiled. Shown here is an artist's representation of the general layout of the plant that will handle it. Ore dumped from cars in the building at the upper right will drop into one of two 360-ton hoppers feeding a conveyor that will deliver it to either a freighter or a stock pile. If shipbound, it will go into one of the 1000-ton bins just beyond the right end of the vessel and out through a bottom opening onto a conveyor, the purpose of this being to help mix ore of different grades. The latter conveyors will feed two shiploaders that will move transversely on rails spaced 70 feet apart so as to reach any of a vessel's hatches. Ore to be stockpiled (upper part of picture) will be transported underground to a mobile stacker that will elevate it and discharge it on either side. Only one of the two loaders shown will be installed at present. Ore from a stock pile will be transferred by an 8-yard electric shovel to cars and then dumped and delivered aboard ship as described. These facilities will have a maximum shiploading capacity of 8000 tons per hour but normally will load at a rate of 6000 tons into freighters and 3000 tons onto stock piles.

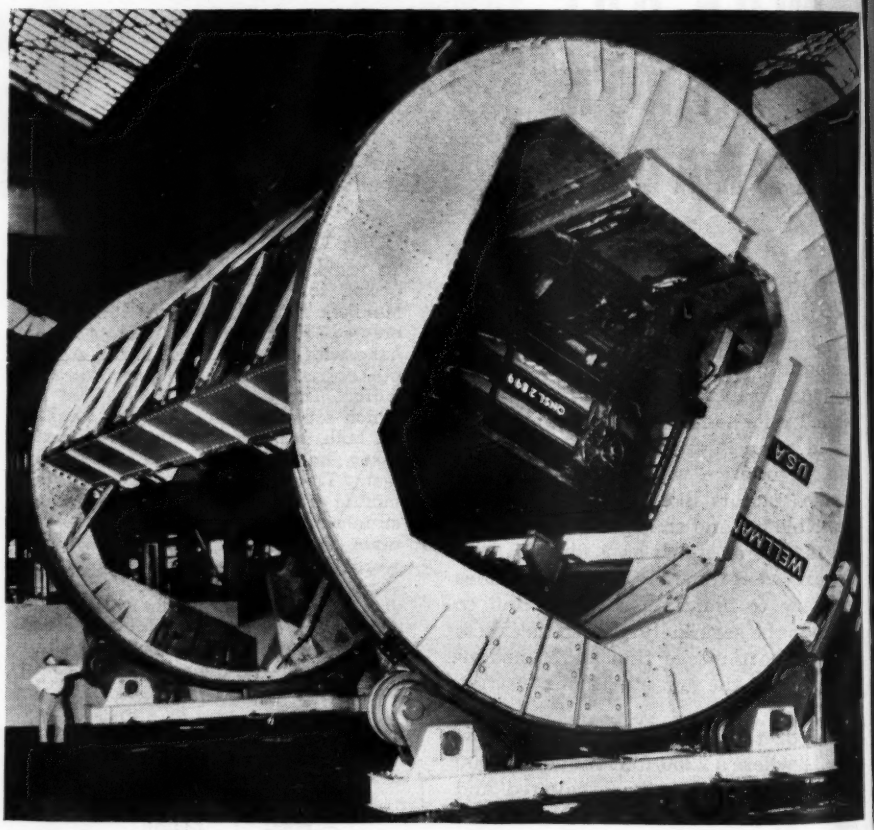
pression of folded and faulted strata. The vegetation is predominantly evergreens with occasional patches of birch, but the higher hills are bare except for caribou moss found throughout the subarctic. Towards the north the trees gradually become smaller and the hardwoods disappear. However, sufficient timber is available for local building needs and firewood.

By normal standards, the climate is severe but not too much so for those who are prepared for it. Winter temperatures occasionally reach minus 50°F but often climb to above freezing. The prevailing high winds are extremely annoying and definitely an obstacle to outdoor work and flying schedules. Nevertheless, climatic conditions are not such as to prevent the operation of open-pit mines for five to six months of the year.

Despite the fact that the land flattened out, construction of the railroad northward beyond Mile 150 was no cinch. The biggest headache was mu keg—spongy decomposed moss with a average depth of 5 feet. More tha once it has swallowed up equipmen and because its rotting action preven freezing, tractors must plow snow in it to make winter roads. Much ingenui was displayed in building the railwa Dynamite charges had to be placed such a way that muskeg would be blaste aside, permitting gravel fill which ha been dumped on top of it to settle o bedrock. Although equipment, materials and supplies for the operation were brought in by air lift and by the line itself as rails extended northward, more than 200 miles of service and access roads were constructed parallel to the right of way.

Engineers kept the job on schedule despite the many difficulties. One innovation enabled them to save considerable time. They avoided switching rail-carrying flat cars by using only the car trucks with the rails themselves constituting the longitudinal joiner. These trucks could readily move over newly laid, lightly ballasted track and had the added advantage of being easily handled by the rail cranes.

Another wrinkle that made for rail-laying progress had to do with ballast-

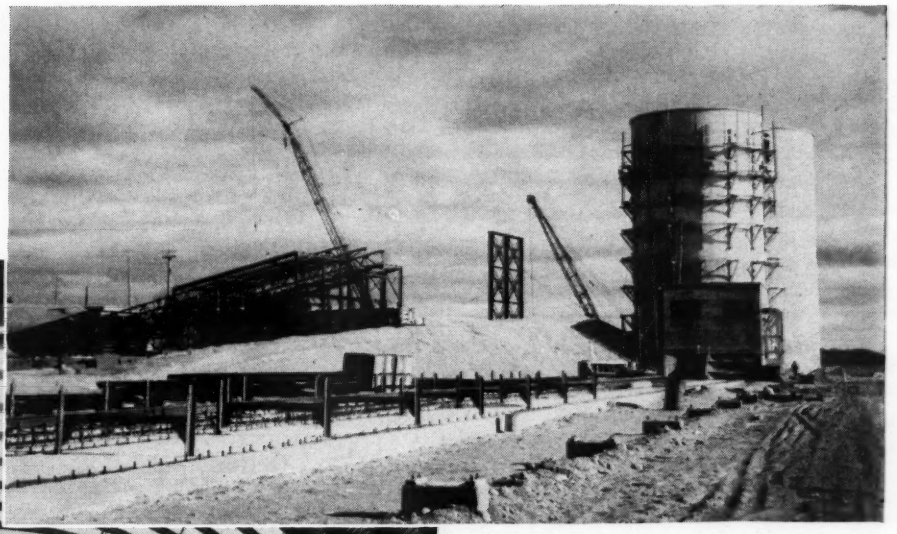


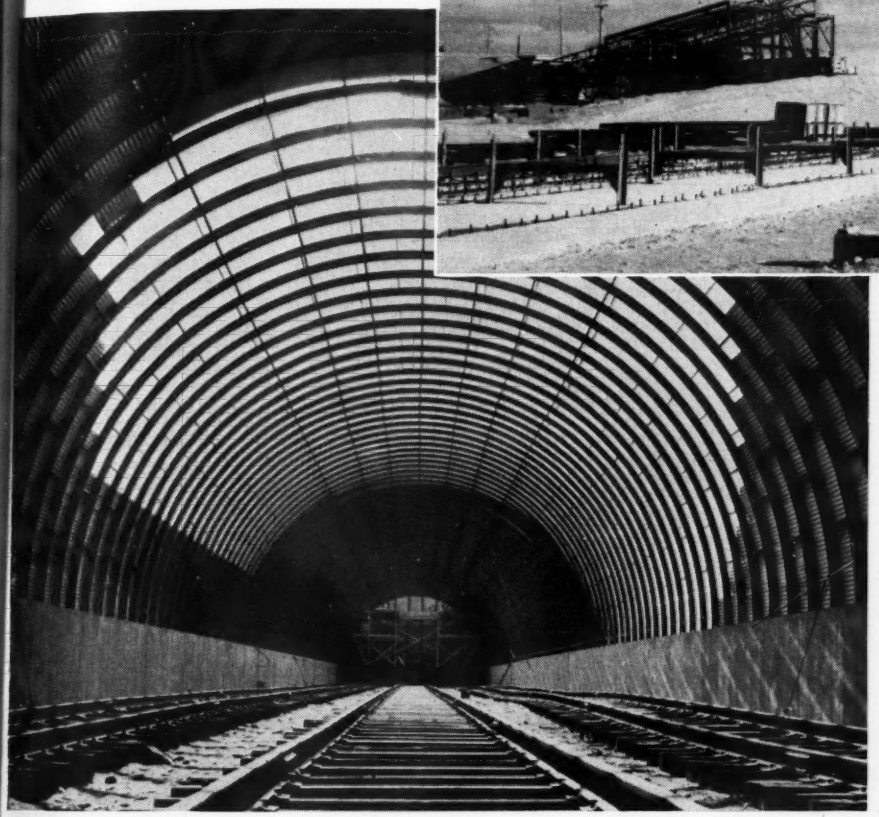
CAR DUMPER

Cars of ore arriving at Seven Islands will be dumped by a Wellman rotary mechanism like that shown. Two units will be arranged end to end and may be operated separately or together. As a car enters a dumper its speed will be accelerated to push out the empty ahead of it. Then it will be stopped in position for unloading by an air-actuated retarder controlled by the dumper operator. Air will be fed to it from a 260-cfm compressor through hoses long enough to allow for the rotation of the unit.

SEVEN ISLANDS STRUCTURES

Completely equipped shops for taking care of the railroad's 49 diesel-electric locomotives will be housed in the arched structure illustrated below. The other picture shows some of the ore-handling facilities under construction. At the right are the two mixing bins to which the ore will be routed before being loaded aboard ships.





ing. After ballast is dumped on the roadbed, rails must normally be lifted in stages to tamp the rock under the ties with hydraulic jacks or pneumatic tampers. On certain sections of the Labrador Railway, however, a specially designed sled of wedgelike construction is pulled along under the rails by a locomotive and raises them for that purpose.

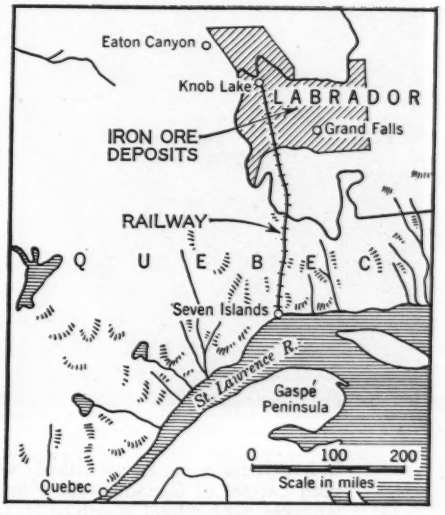
The northern terminal at the mine at Knob Lake will be a common yard for receiving empty trains and dispatching loaded ones made up of 100-115 cars —9000 to 10,350 trailing tons—hauled by four locomotives totaling 6000 hp. Operations will involve the transfer of empties to loading chutes at the screening plant and the return of full cars to the main yard for assembling into trains.

At the southern or Seven Islands end of the line the marshaling facilities—550 acres of more than 40 miles of track —will consist of a receiving yard, classification yard, stock-pile yard, car-repair yard, locomotive servicing shops and a departure yard. When an ore train arrives at the receiving point, it will be directed by signals and remote-control switches, and when part way in the yard the caboose will be detached and run by gravity to the departure yard. From there it will again be shifted by gravity to the rear of a train bound northward for Knob Lake.

From the receiving yard the loaded train will be "humped" into the classification yard where the ores are to be graded. As each car passes over the hump, it will be weighed automatically by an electronic scale and checked from an inspection pit. If found defective, it will be branded by moving a lever. After classification, the cars will be hustled by between-track side-pusher engines to a tandem dumper that will turn two cars upside down at one time. The ore will go to crushers and from there by conveyor belts either to ships or stock piles. Empties will travel by gravity from the dumper to assigned tracks in the departure yard, an operator in a tower controlling their speed with retarders.

Another important job was the construction of two hydroelectric stations. One of these on the Marguerite River at a point 15 miles west of Seven Islands can supply 23,000 kw for the rail yards and ore-handling facilities and for the greatly expanded town of Seven Islands. This joint project of IOCO and the Gulf Pulp & Paper Company features a 610-foot diversion tunnel and a 517-foot concrete dam 128 feet high with a mile-long earth section.

Ten thousand kilowatts of energy for the mine workings and the community at the north end of the line will be supplied by the Menihek powerhouse on the Ashuanipi River 30 miles southwest of Knob Lake. Designed by a firm of consultants, the Montreal Engineering Company, its 12,000-foot dam, which will also serve as a railway bridge, consists of a series of concrete piers with a low earth embankment on each side and of a 300-foot gated, concrete spillway to take care of run-off during periods of high water. Construction equipment was hauled overland from the nearest air strip in tractor-drawn convoys on 6 feet of snow, and the job also presented something of a problem in river diversion. The dam and generating plant



REGIONAL MAP

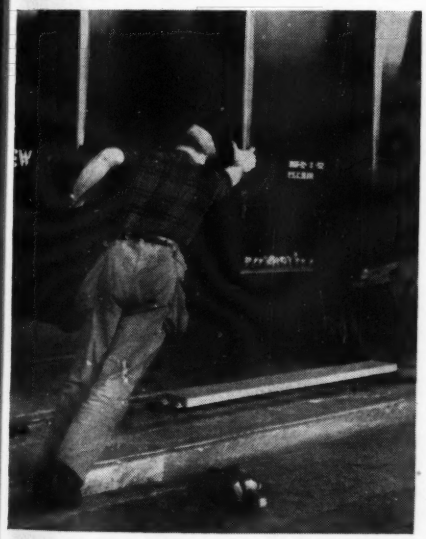
The first trainloads of iron ore have already rumbled down to the St. Lawrence. Millions of tons will follow in the years to come.

CANADA'S FUTURE DULUTH

In five years or so, Seven Islands will become the ore-shipping capital of Canada. As a first step in that direction wharves, with a total length of 1600 feet, are being built in the natural deep-water harbor. The settlement was three centuries old last year, but as a quiet fishing and forestry village it never had more than 1400 inhabitants. Now the iron boom has swelled the population to 4000, and it is expected to reach 6000 to 7000 by 1956 and eventually 12,000 to 15,000 when ore shipments amount to 20 million tons a year—the present objective. To transport the influx of workmen over the sprawling area the number of taxicabs has jumped from 2 to 60. The mushrooming town, with an administrative budget that never exceeded $7000 a year, is facing the problem of raising $900,000 to provide adequate sewerage and water systems and $450,000 for paving streets and building schools. It has no rail or highway connections with "the outside," but 150 miles of roads extending upriver toward Murray Bay have been contracted for.

POWER FOR TUNNEL DRIVING

A 2250-foot tunnel was driven at Mile 12 to carry the railroad through a rocky height bordering the Moisie River. Blastholes were drilled from a truck-mounted carriage with operating air supplied by the three Canadian Ingersoll-Rand 500-cfm portable compressors pictured. From the northern portal of the tunnel the line emerges onto the longest bridge in the system.



ROLLER-BEARING CAR

Each of the 2000 ore cars of the Quebec, North Shore & Labrador Railway will have sixteen Timken roller bearings and a husky man will be able to move one of them.

are completed and machinery is now being installed. Power will be available this year.

The Marguerite and the Menihek plants will meet IOCO's initial requirements, but two other excellent hydroelectric sites are available for future development. One of these, at Eaton Falls on the Kaniapiskau River and 70 miles north of Knob Lake, offers 500,000 hp. Grand Falls, on the Hamilton River to the east, can furnish 1,250,000 hp. The great potential of the area can be appreciated from the fact that the Hamilton River watershed alone could provide an estimated 10 million horsepower, which would make it the largest hydroelectric development in the world.

When the IOCO project was started, the fishing wharf at Seven Islands was too small to handle the increasing number of supply boats. The contractors therefore went to work in a hurry on a temporary timber-and-concrete dock and at the same time put plans on drawing boards for the extensive facilities that will be needed to handle 20 million tons of ore a year, as contemplated.

The C. D. Howe Company Limited of Montreal was named consultant for the job, with D. H. Sharpe as project engineer. The permanent site selected for the pier is at Point aux Basque, just east of Seven Islands, which offers ocean-going carriers the most favorable deep, safe anchorage in a harbor free from ice for at least nine months of the year. So that as many as three vessels could tie up at once, a 1600-foot stretch of dock was specified and positioned so that the necessary 37-foot draft could be readily maintained. The plans also called for 6000 feet of tunnel and gallery for conveyor belts to move the ore from the dumper house to storage or to ships waiting at the pier.

Two wing-type gantries at the stock piles will build the ore mountain high until it is needed for shipment. On the wharf are two gantry-type loaders with a combined capacity of 8000 tons per hour, which means that a large ore carrier can be loaded in about five hours. The entire system is geared to handle 70,000 tons daily.

Built over deep sand underlain by clay, nearly all the structures of the ore-handling plant are supported on piles. The work of sinking them was speeded up by the use of compressed air, which operated the pile hammers and the utility hoists with which they were provided to pick up the piles prior to driving. The air was supplied by Canadian Ingersoll-Rand 500-cfm portable compressors and was also used to power pneumatic grinders and chippers that served to smooth beads on welded sections of sheet piling. Fill for the dock came from two quarries and was handled by clamshell buckets. Chunks that were too big for the purpose were pop-holed with Jackhamers. Wherever timbering was needed on the job, air-operated woodborers made short work of drilling bolt holes for the connectors.

C. E. MCMANUS

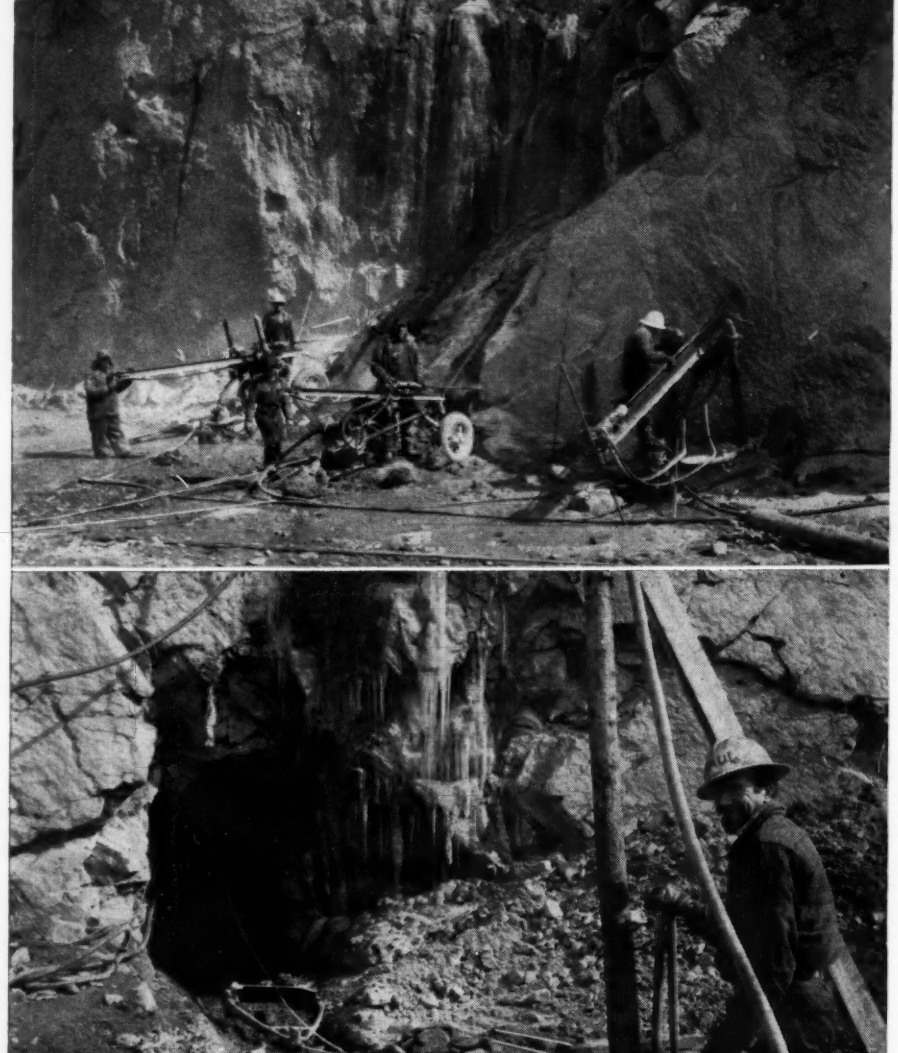
As assistant general manager in charge of mining, he has the task of starting and keeping the ore flowing from the pits and is also concerned with building the town for the mining force.

JOHN A. LITTLE

Experienced in both railroading and mining, he was given the job of overseeing construction of the railroad and transmission lines and looking after warehousing and stores at Seven Islands.

DR. A. E. MOSS

Now chief geologist for IOCO, he was assistant to Dr. J. A. Retty when the latter directed the first detailed geological examination of the remote area where the ore deposits are located.



QUARRYING BALLAST

One source of ballast for the railroad was a quarry at Mile 16. At the top, Canadian I-R Wagonjack drills are attacking the rock face. The other picture shows a "coyote" hole which was later loaded with powder to blast down a large quantity of rock. In the foreground is a small I-R air hoist furnishing power for the removal of muck with the scraper in front of the portal.

With 500 million proven tons of high-grade ore to be sent to market, IOCO's manager of mines, C. E. McManus, has had a big job planning the workings beyond the Knob Lake terminus. Limited shipments during 1954 (1-1.5 million tons) while the railroad bed settles will give him a chance to put operations into high gear for a productive 1955. The mine requires a great variety of heavy machinery and handling equipment, most of which must function the year round at temperatures ranging from an average daily minimum of minus 23°F in January—the coldest month—to an average maximum of 69° in July. Because ore in transit will freeze in the cars at low temperatures, rail transportation will be limited to 5½ months per annum and enough must be produced and hauled in that period to keep Seven Islands busy during its 9-month season. Therefore, the plan is to stock-pile 2,000,000 tons at the port each year.

Getting the ore into the cars involves excavation at the pits; transportation from the pits to the screening plant; screening and crushing; and loading. Ruth Lake No. 3 Pit has been partially stripped of overburden and the screening plant for this deposit is nearing completion. The pit will be about ½ mile long and 800 feet wide and will eventually be worked to a depth of 350 feet. Two other pits are expected to be opened during 1955. Underground mining is not contemplated in the immediate future, but exploration indicates that it may be feasible at a considerably later date. Preparation of the pits is not difficult because the ore, for the time being, is lightly covered and will be reached well above the level of the water table.

Initial stripping is being done by three diesel-powered 2½-yard revolving quarry shovels. Once this preliminary operation is completed, four Marion 6-yard electric shovels will take over. These units, each with a working weight of 416,000 pounds including 50,000 pounds of ballast, will scoop up approximately 12 tons of iron ore with each stroke of the boom. Rail spurs will not enter the pits. For the tough job of taking a 12-ton shock load of ore from the shovels and hauling it away for screening or stock-piling, a primary fleet of twelve rear-dump Euclid diesel trucks has been selected. Each weighs 66 tons and has a capacity of 23 cubic yards or 34 tons of ore. They are the largest in service in Canada.

The trucks will roll into the screening-plant bay and dump their loads through an opening 14 feet square into a steel hopper equipped with air gates. From the hopper the material will be discharged through an opening about 5 feet across and 12 feet long onto a 5-foot-wide primary apron feeder of the roller-track type. This unit has a capacity of 1920 tons per hour and will deliver the ore to a 6x12-foot single-surface screen with a circular throw action. Anything larger than 5 inches will be tossed onto a secondary apron feeder, while smaller pieces will fall through a large screen hopper onto a third apron feeder connecting with the final conveying system in the screening plant.

Oversize material on the secondary apron feeder that is acceptable so far as the rock content is concerned will go to a crusher delivery chute, while that with too high a rock content will be diverted to a hopper by reversing the feeder and will eventually be trucked to a waste pile. Ore not exceeding 24 inches in size will be reduced to a maximum diameter of approximately 4 inches at a rate as high as 275-300 tons an hour by a 42x48-inch, 176,000-pound Traylor jaw crusher resting on a reinforced-concrete foundation. The crushed material will flow through a chute onto a 36-inch conveyor that will take it at a speed of 610 feet per minute to

the building housing the loading pocket. This carrier will handle hourly up to 1600 tons of ore weighing 125-150 pounds per cubic foot. All this equipment—apron feeders, screen, crusher and conveyors—will be controlled by an operator from his cabin in the loading bay. The loading pocket is 14 feet 2 inches wide, 29 feet 2 inches long, and 21 feet deep. It has a capacity of 360 tons and will discharge through four duplex gates which, acting singly or at the same time, will fill a car without having to move it.

At Knob Lake, renamed Schefferville after the Bishop of Labrador, is being built what will be the most northerly community in the Province of Quebec. It is scheduled for completion this year and will consist of a general warehouse, bunkhouse, cookhouse, ten staff houses, more than 75 private homes and a school for the mining and development workers and their families.

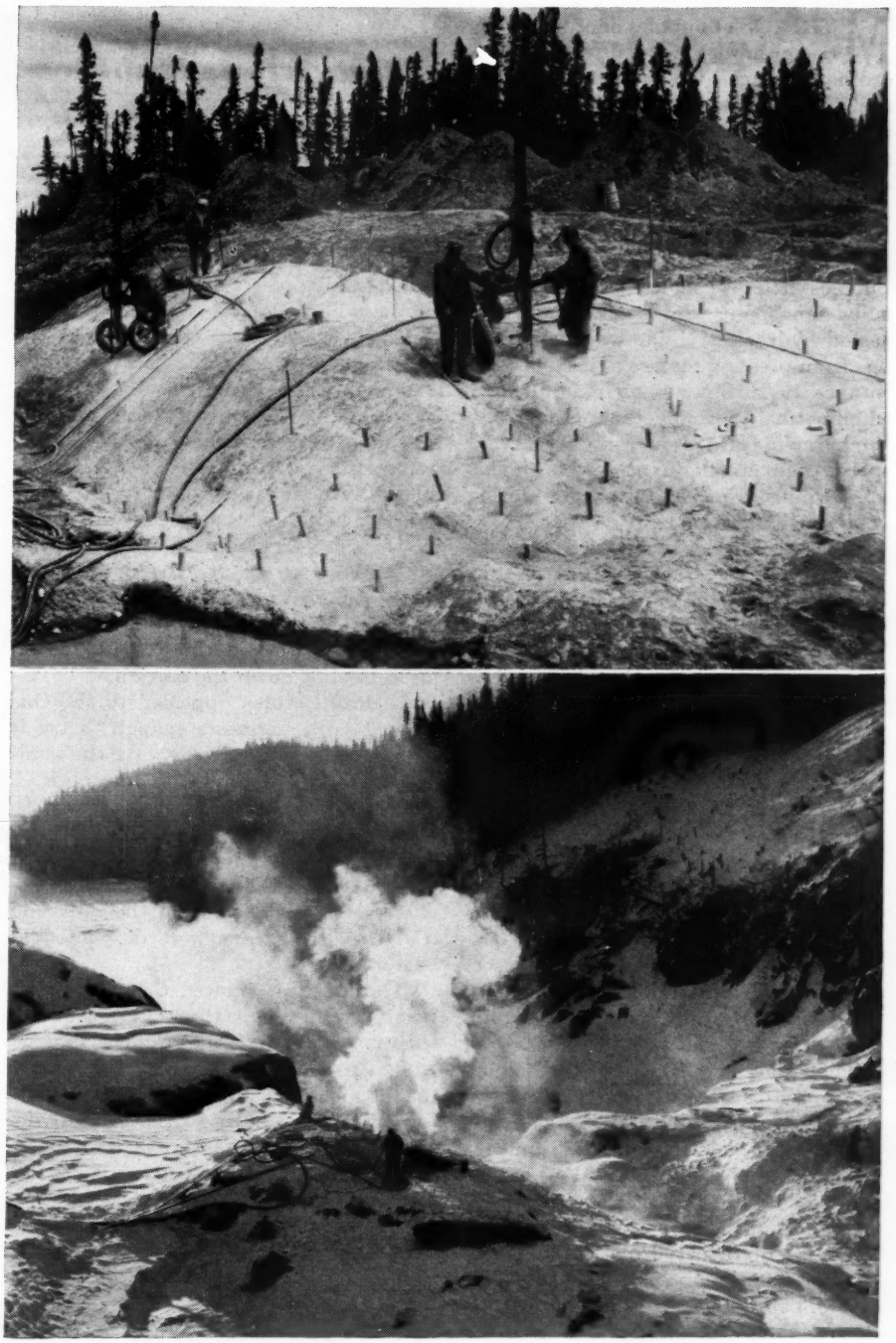
In the first installment of this article it was mentioned that steel authorities in the United States had estimated as late as 1945 that their mills would not require iron ore from Canada for 50 to 75 years. But subsequent developments such as the Korean War and the cold war now make it clear that up to 40 million tons a year will be needed from foreign sources. For security reasons it is obviously preferable that the bulk of it should come from Canada rather than from South America or from across the Atlantic.

With that in mind the IOCO project was designed for expansion to 20 million tons a year.* There is a fly in the security ointment, however, because most of that tonnage, for lack of adequate deep water to ports on the Great Lakes, would have to take an unguarded route to seaports such as Baltimore and Morrisville on the east coast of the United States. Therefore, an inland shipping lane is imperative not only in the event of war but, for economic reasons, also if peace should prevail. As early as 1952 the U. S. Materials Policy Commission endorsed the deepening of the St. Lawrence River to 27 feet on the basis of the expensive boat and rail haul to Pittsburgh and Chicago. The fact of the matter is that the output of IOCO holdings cannot be appreciably increased economically without the St. Lawrence Seaway.

Under the present setup, ore going to Cleveland, Youngstown and other inland United States ports will have to be transferred at Montreal to smaller carriers that can pass through the existing 14-foot locks along the St. Lawrence between Montreal and Lake Erie. This route is heavily burdened and, it is estimated, could probably not take more than 1,500,000 tons of Ungava ore annually. Nevertheless IOCO is going ahead with transhipment facilities at Contrecoeur near Montreal.

The importance of the St. Lawrence Seaway has been well summed up by the prominent international steel specialist and businessman, Sir James Dunn, who said that until it is dug North America will remain "woefully derelict" in her duty to all people. "Without the freest entry to the Great Lakes waterways of the iron ore of the Quebec-Labrador country, our raw material picture is not complete."

Iron Ore Company of Canada went into production officially on July 31, when Premiers Maurice Duplessis of Quebec and Joseph R. Smallwood of Newfoundland joined in ceremonies marking the loading of the first boat with ore at Seven Islands. The 19,000-ton cargo, carried by the converted C-4 freighter *Hawaiian*, was consigned to Philadelphia, Pa., where August 5, the day of its arrival, was celebrated as Quebec-Labrador Day.



DRILLING SCENES

Wooden plugs mark the locations of holes already drilled (top view) as two wagon-mounted Canadian I-R Jackhamers continue their attack on the outcropping rock at Mile 201 on the railroad right of way. The lower picture shows drillers in a wintry setting at the site of Marguerite Dam.

*So huge an output would require a second dumper and some yard additions, but the main rail line would need little if any alteration. Twenty-two sidings along the right of way for sidetracking provide for a schedule of 36 trains a day, an increase of twenty-two over the number estimated for the shipment of 10 million tons of ore a year.

Miraculous Bubbles

Gurgling globules cushioned rock blast at Niagara and saved a million dollars

MYRIADS of bubbles of ordinary air rising through water do some extraordinary things. On the prosaic side is their service to wild life. Injected beneath ice caps on fast-frozen ponds they supply life-giving oxygen to fish. Introduced into lakes before freezing takes place they maintain open water all winter for migratory geese and ducks.

In the field of industry, the evanescent bubbles achieve more spectacular results. For many winters they have protected hydroelectric dams against damage from pressing masses of ice and kept intakes to turbines open regardless of plummeting thermometers. Similarly, lumbermen learned in recent years to utilize them in order to prevent log ponds at sawmills from freezing over during cold weather.

Older than either of these applications is the idea of the Brasher compressed-air breakwater for calming raging seas, which is described elsewhere in this issue. The outstanding feature of all these operations is their utter simplicity. They require no more than some perforated piping fed with compressed air.

Up in Canada a new and equally amazing way of putting the tiny bubbles to work is credited with having saved a million dollars at its first trial. Creating a compressible curtain in the water of the forebay of the huge Adam Beck No. 1 generating station, the globules absorbed the shock of blasting out a 12,000-cubic-yard plug of rock with 6 tons of explosives, leaving the upper portion of the powerhouse, only 85 yards away, unscathed.

The scene of this remarkable demonstration is the point where two great streams of water, taken out of the Niagara River 6 miles upstream from the falls, converge to form a pond or forebay that feeds water to either of the two adjacent Adam Beck power plants—Nos. 1 and 2—of the Hydro Electric Power Commission of Ontario. The 500,000-hp No. 1 station has been in operation for 34 years and is served by its own waterway. No. 2 station, which will eventually house spinning turbines rated at 1,828,000 hp, is now nearing completion. A separate conduit, consisting of a tunnel underneath the city of Niagara Falls, Canada, and an open canal elsewhere, was built to supply it with water. When the forebay for No. 2 plant was excavated, a rock wedge was left between it and the adjacent pool servicing No. 1 station. In order that the powerhouse might receive water from either system, the engineers had to join the two forebays by removing the rock barrier.

Because water is noncompressible and would transmit the shock of the blast directly to the superstructure of No. 1 plant, the obvious procedure would have been to close down the generators, drain No. 1 forebay and blast out the obstruction "in the dry." That would have entailed buying power at an estimated cost of one million dollars.

However, Adolph LaPrairie, an explosives expert for Canadian Industries Limited who served in an advisory capacity in determining the blasting technique, was familiar with some of the remarkable accomplishments of air bubbles. Why not, he thought, build an "air cushion" in the forebay of No. 1 powerhouse to dissipate the waves of concussion set up by the detonation? If the scheme worked, the entire 25,000-odd-ton rock plug could be shattered with one blast and there would be no need to shut down the station.

LaPrairie's idea appealed to the Ontario Hydro engineers enough to try it out on a miniature scale. At the commission's laboratories in Toronto, R.C. Jacobsen, a physicist, and A.T. Edwards, an engineer, rigged up a tank of water bisected by three perforated air pipes on the bottom. Sensitive pressure gauges were set up at one end of the tank and C-I-L blasting caps were detonated at the other.

The first test showed them that they were on the right track, but that adjustments were needed. For two months they experimented, varying the volume of the air released and the diameter and spacing of the holes in the pipe to determine what size and quantity of bubbles would be most effective.

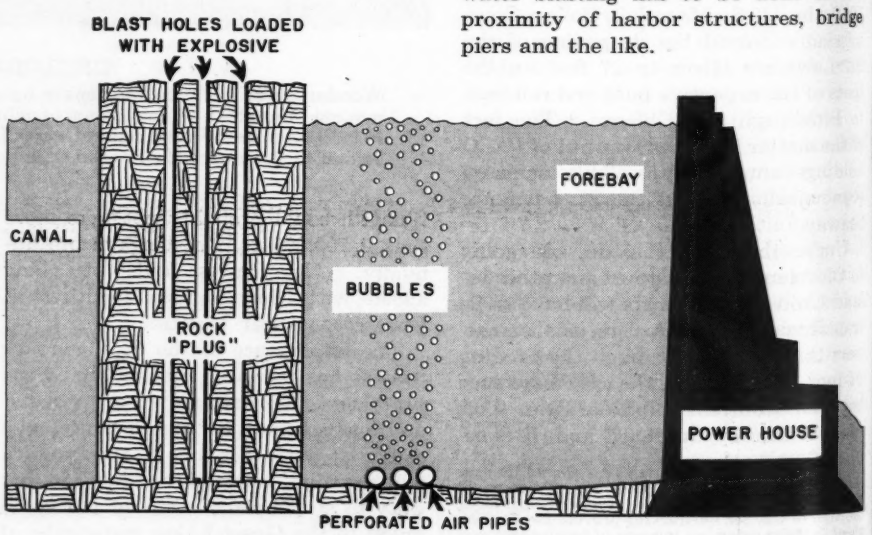
From the information gained they laid out, full scale, the piping necessary to produce the desired dampening effect. Three 3-inch lines, each perforated with 36 holes per foot, were clamped together 9 inches apart. They were closed at one end, and a 6-inch air-supply pipe was manifolded to the other ends. The assembly was then lowered to the forebay floor, crossing it on a line parallel to the face of the rock plug and the powerhouse but farther away from the latter.

Vertical blastholes that had been drilled in advance in the rock barrier were then loaded with "Nitrone," an explosive that was selected because it is not highly sensitive to propagation and comes in water-excluding steel containers.

To be on the safe side, the headworks of the generating station were protected with bags of sand, but this precaution proved to have been unnecessary. The air cushion, composed of millions of compressible bubbles, absorbed the concussion so well that the hammering effect transmitted through the water to instruments at the building wall was only 1/70 as intense as it would have been without the shock absorber. It was not strong enough to be damaging and, far below, the turbines kept on spinning the generators without a break.

Based on the calculations made by the engineers during their experiments, the desired cushion of bubbles was obtained by forcing 90-psi compressed air into the piping system at a rate of 3750 cfm. The upward rush of the churning air raised the surface of the water about 4 feet above the normal level. The installation cost amounted to around $2000.

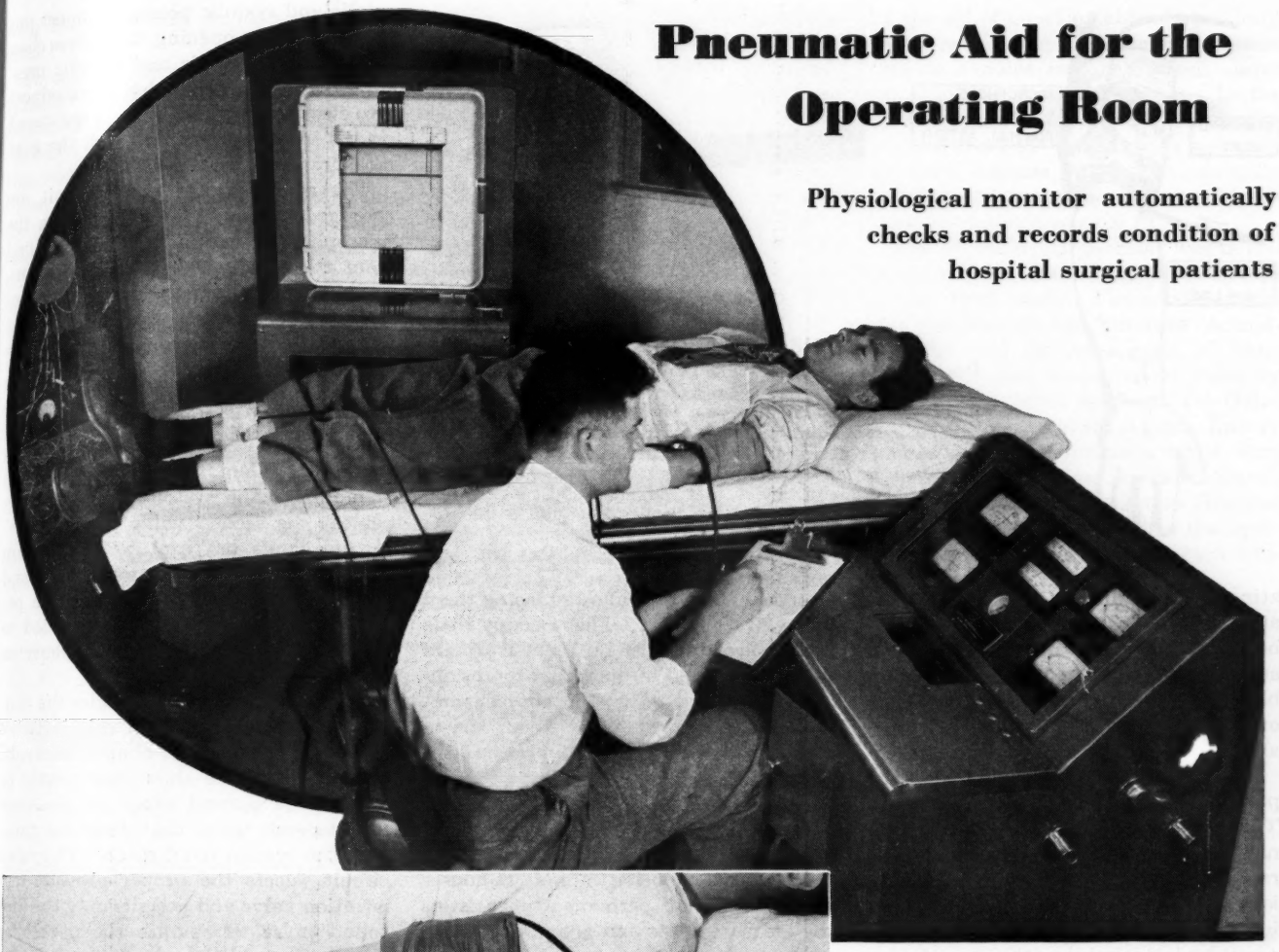
Following this initial success, the same scheme was used down in the Niagara gorge to soften a blast that removed a similar ledge of rock from between the stream and the tailrace excavation for the new plant. This second air curtain was 750 feet long. Canadian Industries Limited has applied for a patent on the technique and believes that it can be applied to advantage wherever underwater blasting has to be done in the proximity of harbor structures, bridge piers and the like.



CROSS SECTION OF THE NIAGARA AIR CURTAIN

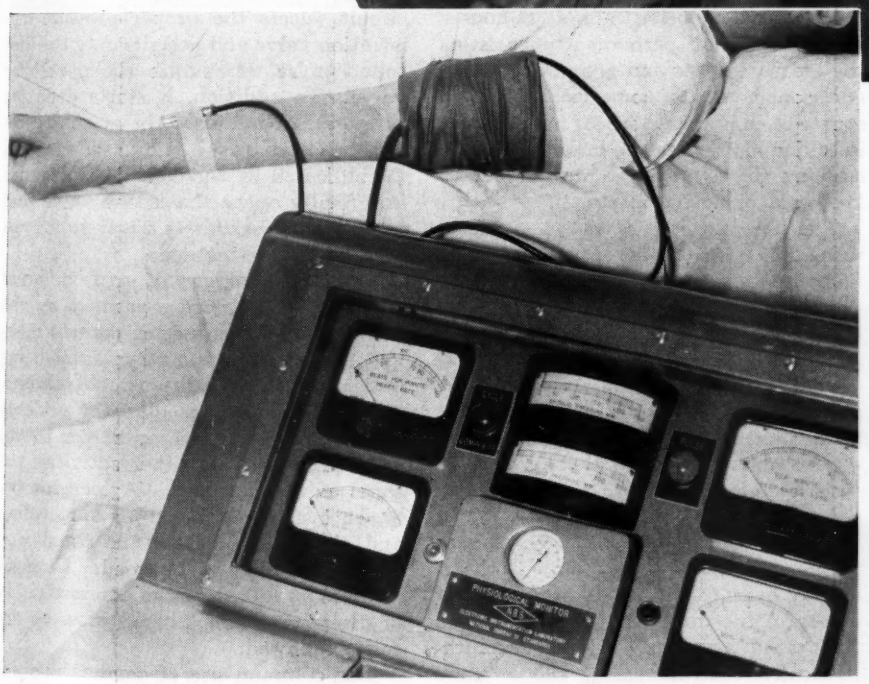
Pneumatic Aid for the Operating Room

Physiological monitor automatically checks and records condition of hospital surgical patients



LABORATORY TEST

The operating-room console, in the right foreground above, indicates changes in blood pressure, heart beat and respiration as they take place. A permanent record of these readings is made automatically on the chart of the recorder console in the background. Electrical attachments on the patient's arms and legs permit continuous measurement of pulse rate and pulse irregularity. The arm band and associate microphone are for taking blood pressure. In actual use, the recorder console is placed outside of the operating room.

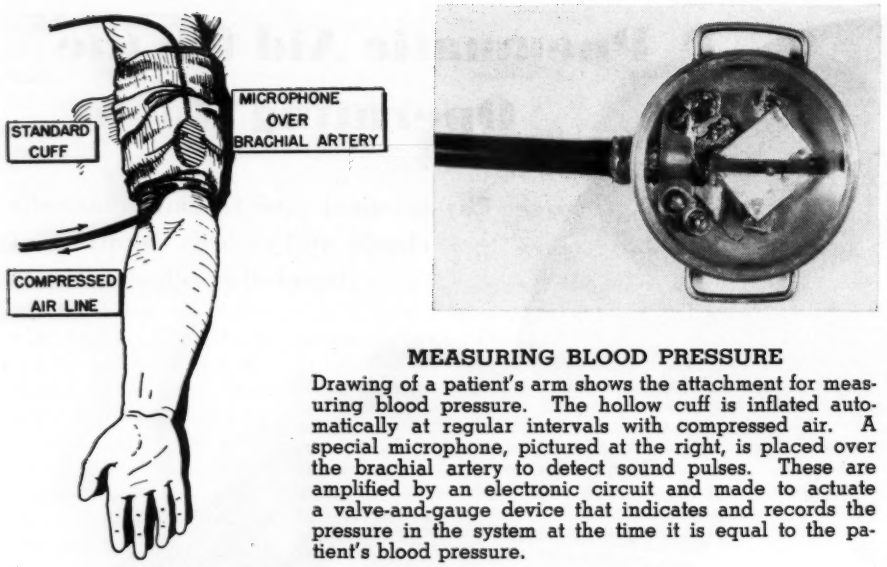


CLOSE-UP OF PANEL BOARD AND ARM ATTACHMENTS

One of the electrodes for measuring heart beat is attached to the wrist while the inflatable band for taking blood pressure is applied to the upper arm. The two dials at the left indicate pulse rate (above) and arrhythmia, or pulse irregularity (below). The two topmost dials in the central column show systolic and diastolic blood pressure. Just above the nameplate is an aneroid barometer that registers the pressure in the hollow arm band and is used in checking the calibration of the blood-pressure indicator. The two dials at the right record respiration rate (above) and respiration volume per minute (below). An indicator light marked "cycle complete" (left upper-center) glows when measuring blood pressure. Below it is a neon lamp that is of aid in adjusting the gain control of the blood-pressure recorder. A light marked "pulse" (right upper-center) is used in establishing the proper lead and gain setting for the individual subject when measuring heart beat. A pilot light below it shows when power is on.

AN ELECTRONIC and pneumatic instrument that automatically detects changes in the physiological condition of a patient under anesthesia throughout the course of an operation has been developed by the National Bureau of Standards. Known as the NBS physiological monitor, it measures changes in blood pressure, heart beat and respiration as they take place and not only presents the information on a panel for interpretation by the surgeon or anesthesiologist but also records it in permanent form. The pneumatic feature of the apparatus is involved with the taking of blood pressure.

The instrument is expected to prove of great value in the prevention and control of emergencies that may unexpectedly confront a surgeon at the oper-



MEASURING BLOOD PRESSURE

Drawing of a patient's arm shows the attachment for measuring blood pressure. The hollow cuff is inflated automatically at regular intervals with compressed air. A special microphone, pictured at the right, is placed over the brachial artery to detect sound pulses. These are amplified by an electronic circuit and made to actuate a valve-and-gauge device that indicates and records the pressure in the system at the time it is equal to the patient's blood pressure.

ating table or during critical postoperative periods. It will most likely also be of assistance in medical research such as in studies of the effects of drugs on blood pressure that require a knowledge of the behavior of physiological variables over long periods.

During surgery it is vital that the patient's condition be known at all times. That is why the anesthesiologist ordinarily measures blood pressure and pulse rate frequently. If necessary he administers drugs, additional anesthetics, or infusions of blood or plasma. However, when he is occupied with other duties, periods between measurements may be prolonged. Normally, this delay is not serious, but it can have unfortunate consequences. For example, when complete circulatory collapse occurs, as in severe blood loss or heart failure, some time may elapse before the condition becomes outwardly apparent. Because time is important in applying remedial aid, the earliest detection of such a crisis offers the best hope of saving the patient's life.

The physiological monitor makes prompt emergency action possible by continually displaying the needful information in simple, numerical form. Data on systolic and diastolic blood pressure (associated, respectively, with the heart's contraction and expansion), pulse rate and irregularity, breathing rate and quantity of air exhaled per minute are available at a glance without intermediate calculation or manipulation. Preliminary adjustments require no special technical skill or training on the part of the operator. Safeguards are provided that permit the instrument's use in the presence of highly combustible anesthetic gases such as are usually found in an operating room.

The monitor consists of two metal cabinets—an operating room console and a recorder console—interconnected by a combination compressed-air line and electrical cable that allows placing them up to 20 feet apart. They occupy little floor space and can be moved around without effort. The operating-room cabinet shows the results of all measurements as fast as they are taken and in easily read form. It contains the controls, and is linked with all attachments such as arm band and electrodes on the patient. The recorder console is located outside of the operating room where there are no explosive vapors. It houses a recorder that permanently registers the measurements and is equipped with additional circuit components and a source of compressed air for use not only in taking blood pressure but also in pressurizing the operating-room cabinet to keep out explosive mixtures.

The new automatic system of measuring blood pressure is based on the same technique practiced by an examining physician. He forces air into a hollow band or cuff wound around the upper arm until the systolic pressure is exceeded. Then he gradually lowers the pressure and determines systolic and diastolic pressures by noting the reading on a manometer when certain characteristic pulse sounds in the artery are detected with a stethoscope.

With the automatic method, a microphone is located at the point of observation over the brachial artery (chief artery of the upper arm). Every three minutes an air-supply valve opens automatically, thus increasing the pressure in the arm band. As soon as it exceeds the diastolic pressure, the microphone begins to pick up sound from the artery. When this sound reaches its maximum it begins to decrease, ceasing after the pressure in the cuff is higher than the systolic pressure.

By means of amplifiers and relays, the pulses picked up by the microphone actuate two solenoid valves which open to connect the air system with the proper pressure-indicating gauges at the diastolic and systolic points. Almost immediately after opening, the valves close so that the diastolic and systolic pressures—now converted by a transducer into electrical signals—remain registered on the indicating meters until the next measurement cycle begins.

The amplifier and relay circuit are arranged in such a way that when the microphone receives the initial sound from the artery the first valve opens, permitting the adjacent gauge to record the diastolic pressure. Because the point at which sound stops cannot be determined until that point has been passed, the pressure is carried beyond the systolic pressure and then allowed to decrease slowly until that pressure is again reached. When the first pulse corresponding to the systolic pressure is received, the second valve opens, allowing its gauge to "capture" and retain the instantaneous pressure. The band is then rapidly deflated so that the period during which pressure is applied to the patient's arm may be as short as possible.

The entire procedure is under the control of a program switch that initiates the measurement at 3-minute intervals. Actually, it takes about one minute or less in the normal range of pressures but depends upon the maximum pressure the system must reach. The relay circuit selects the proper pressure-registration valve and permits only the first sound pulse to operate the particular valve. In addition, it starts deflation of the arm band after the systolic pressure has been exceeded by a safe margin (as indicated by the cessation of sound) and finally opens the second valve that rapidly deflates it after the systolic pressure has been recorded.

The blood pressure of many different individuals has been measured by the physiological monitor for periods ranging from an hour to as long as 21 hours under hospital conditions. In general, it does not seem to cause the patients any discomfort and permits them to eat, sleep and carry on other activities the same as bed patients. Agreement between instrument blood-pressure values and those obtained in the usual way has been found to be good. Changes in pressure following the administration of drugs that affect blood pressure are easily followed.

The common use of combustible anesthetic-gas mixtures makes it necessary to furnish safeguards against potential explosive hazards. Electrical equipment of the type required in the operating-room console contains voltage sources, contactors, motors and numerous hot filaments, all of which could ignite the gas under certain conditions. Equally dangerous are possible accumulations of static on the surfaces of the equipment, as well as accidental connection of the instrument housing or any of its parts

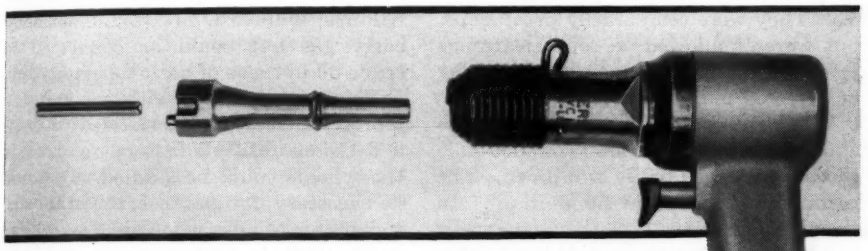
with the power line through insulation failure.

To prevent the accumulation of electrostatic charges, the operating-room console is mounted on conductive rubber casters grounded to the metal frame. However, the use of explosionproof fixtures, as in fixed electrical installations for power-line equipment, was not considered feasible for a portable unit of this type. Instead, it was decided to maintain low positive pressure within the cabinet. This made it unnecessary to seal it hermetically, but reasonable care was taken to minimize leakage by restricting the size of openings. Thus, for example, the instrument panel is covered with a sheet of safety glass and sealed to the instrument case by a rubber gasket and compression frame.

Housed in the recorder console is a sliding-vane compressor that supplies the air that keeps the operating-room console under about ½-pound pressure above atmospheric. Before it is delivered to the cabinet, the air is cooled by passing it through a heat exchanger. Noise is eliminated by an acoustic filter located at the inlet side of the compressor. Safeguards are provided that prevent any power from reaching the unit in the operating room until the purging pressure is at work. In fact, a time delay makes certain that current cannot be applied until the purging system has functioned for about two minutes.

The device used to measure blood pressure also has a safety feature that protects the arm of the patient against excessive pressure or, what is worse, long periods of pressure that would obstruct the flow of blood. It is a mechanical pop-off valve that opens and relieves arm-band pressure when the system pressure is higher than the preset value. In addition, the cuff is deflated by the aid of an adjustable electric limit switch whenever the system pressure exceeds a point reasonably well above the patient's systolic pressure. In the event of power failure, the air is discharged from the system by a solenoid-operated exhaust valve that normally performs this function after every blood-pressure determination.

The physiological monitor was developed by S. R. Gilford and H. P. Broida of the NBS staff. Financial support was provided by the Veterans' Administration and by a program of basic instrumentation sponsored at NBS by the Office of Naval Research, the Office of Air Research and the Atomic Energy Commission. Preliminary triâls were carried out in medical wards at Mount Alto Veterans' Administration Hospital in Washington, D. C., and in the operating room of George Washington University.



EFFECTIVE ADAPTATION

The two pictures show the air hammer, the driving set and the Rollpin fastener before and after assembly. The tool is an Ingersoll-Rand pistol-grip Type AVC-11, one of four sizes used for this work. It has an over-all length of about 9½ inches and is operated with air at 90 psi line pressure. The slot and two openings in the special driving head for the insertion of the pin are plainly visible in the view below.

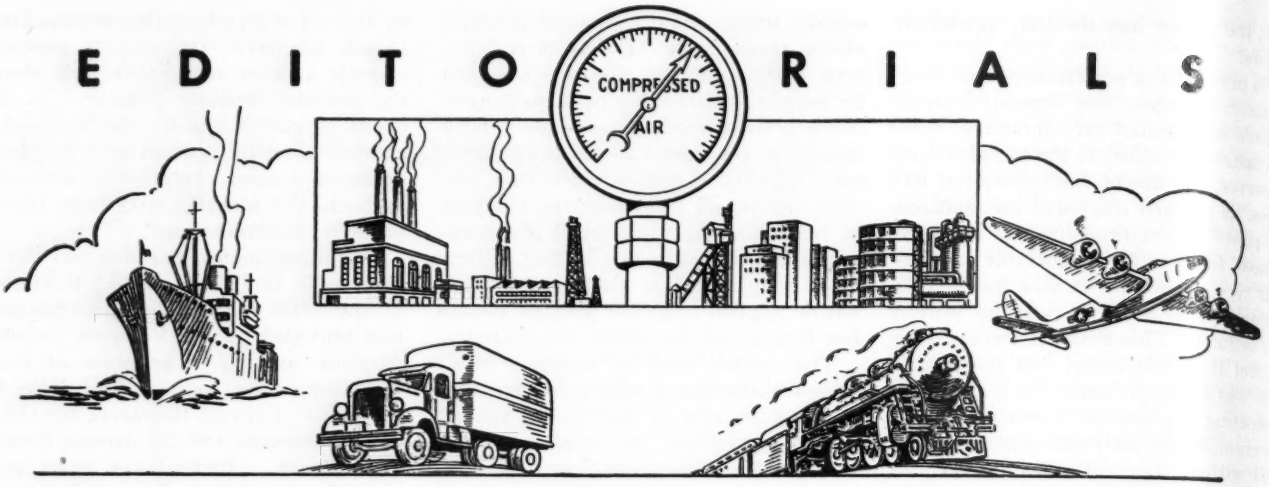
Special Head Converts Riveter into Pin Driver

TO FILL the gap between hand-tool and machine applications and to give the manufacturer a more complete range of assembly methods from which to make a choice, Elastic Stop Nut Corporation of America, in coöperation with Ingersoll-Rand Company, has developed a power-tool attachment for driving its Rollpin fastener. The latter is a tubular split pin slightly larger in diameter than the hole into which it goes. It serves in place of solid, serrated and taper pins; as a dowel, axle or key; and as a hinge or clevis pin. When being forced home, the fastener contracts; when in position, expansion holds it tight against the hole wall.

The tool itself is the standard I-R pneumatic riveting hammer widely used in the aircraft industry. It is light in weight and provided with a safety-type coil-spring retainer in which the special driving head is inserted. The latter has a slot machined in one side to take the Rollpin, an arrangement that permits the operator to hold the fastener without getting his fingers between it and the tool, as an accompanying picture shows. After it has been driven partway it may be shifted either to an opening in the face of the head or in a stud projecting from it, depending upon whether the pin is to protrude, to be hammered flush with the surface or countersunk.

One of the characteristics of the AVC Type riveter that makes it suitable for this work is its sensitive throttle control that enables the operator to vary its performance with the job. As a result, he can start driving a Rollpin at low speed and with light blows and then hammer it home under full power, which is determined by the size and diameter of the fastener, the materials being assembled and other factors.

EDITORIALS



A WORD FOR THE RAILROADS

TWENTY-ONE manufacturing concerns have banded together to try to help out an old and valued friend and customer. It's not a wholly unselfish gesture because if the customer prospers the sellers will too. The customer is the nation's railroads, which are healthier than they were a few years ago but still not exactly robust. Admittedly the backbone of the country's transportation system, the rail carriers are continually being squeezed between competition and regulation and never make any worth-while profits unless our entire economy is moving at top speed. When revenues sag, the roads have to retrench and defer improvements that they would like to make in order to better their competitive position.

The mission of the 21 railway suppliers is to educate the public as to the problems the lines face and the efforts that they have made, against odds, to solve them. Through publicity of various kinds they are bringing out that the railroads, contrary to general opinion, are progressive and forward-looking and kept from being more so solely by lack of funds. They are pleading for a better understanding of the carriers' difficulties and a relaxing of the bonds of regulation that sometimes hamstring their efforts. It is contended that their profits would increase if they were given more freedom in running their own affairs, and more money would be plowed back for making improvements.

The plight of the railroads stems from the fact that they were once a monopoly and are still often treated as such despite marked changes in their status. Around 1900, railroading was about the only really big business in the country and was virtually without competition. The lines acquired such power that governmental restrictions were called for and imposed, and ever since then Uncle Sam has had a tendency to keep a hand in their affairs. In World War I he even took over their operation.

As trucks and buses increased in numbers, the railroads steadily lost out. Between 1929 and 1953 their share of the freight business dropped from 75 to 53 percent, with trucks the major gainers. During World War II they handled 90 percent of the freight and 97 percent of government-directed passenger service. They were temporarily prosperous, but weren't allowed to retain earnings in proportion to the mounting backlog of deferred maintenance.

When the conflict ended, the physical equipment of the nation's 233,000-mile rail network was badly run down. The roads went all out to build it up. In the nine years since 1945 they have spent $10 billion on improvements in addition to $63 billion on operation and maintenance. At the height of the movement, in 1948, they were accounting for one-fifth of all the money spent on industrial improvements. But even those huge outlays have not been large enough to do the whole job, and some people consequently think of the railways as old-fashioned and behind the times. The truth is that the Association of American Railroads conducts a research program that is reducing operating costs by $100 million annually.

The campaign for public appreciation of what the rail carriers are trying to do to help themselves was launched at a luncheon in New York with Benjamin F. Fairless, head of United States Steel Corporation, as speaker. He stressed the effect on all business of the current reduction in railroad income. Steel purchases by the systems in 1954, he said, will be 1½ million tons less than they were in 1953, and that means that 16,000 fewer steelworkers will be employed.

"It seems to me," Mr. Fairless declared, "that the Committee of Railroad Suppliers is doing our country a great service — and a very timely one — by launching this nation-wide campaign to give the American people a fresh look at an old and neglected picture . . . to acquaint them with the facts about the railroads, the vital service they perform, the enormous progress they have made, and the terrific handicaps under which they have had to labor."

UNDERGROUND ENERGY SCHEME

THE Government, through the Petroleum Administration for Defense, is weighing the idea of asking the natural-gas industry to build a "Super-inch" line from the Gulf Coast to the Atlantic seaboard. It would normally carry gas but could be converted to crude oil in times of national emergency. Following a meeting with gas-industry representatives, it was decided to defer a decision until all factors involved in the scheme could be studied. It would be necessary, for instance, to obtain customers for the gas who would be willing to have their entire supply suddenly shut off if the line should be needed for transporting oil. The suggested carrier would very likely be 36 inches in diameter and have a maximum capacity of 600 million cubic feet of gas or 750,000 barrels of oil daily.

It was originally hoped that the oil industry would finance such an artery and utilize it in peacetime to move refined petroleum products, with a switch to crude oil if need arose. But this plan fell through because the companies prefer to keep on using their tankships, which represent a large investment. It will be recalled that the "Big Inch" and "Little Big Inch" were built during World War II to transport petroleum and its products after tankers had suffered heavy casualties from enemy torpedoes. The scheme was successful, but the oil industry returned to the sea lanes when the emergency was over and the pipe lines were converted to carrying natural gas.

Fears that the tremendous growth in gas consumption will soon exhaust reserve supplies have been allayed somewhat with the passing years. Although gas sales have increased 235 percent since 1940, and the fuel has been winning from 800,000 to one million new customers per annum since 1950, discoveries of additional deposits are more than keeping pace with the demand. Reserves gained 5.9 trillion cubic feet in 1953 to reach an all-time high of 199.7 trillion cubic feet at the year's end.

This and That

Anthracite Pioneer Retrenches

Lehigh Navigation Coal Company, which has mined anthracite coal in the Panther Valley district of eastern Pennsylvania for 125 years, has ceased all operations there following rejection by its employees of a "work-harder, produce-more" program that it sought to institute. The concern lost $3.4 million on its coal-mining and marketing operations last year. The decision, which the company says is final, removed the oldest active producer from the anthracite lists.

The firm got into the business in a roundabout way. In 1812, Col. George Shoemaker, of Pottsville, Pa., took nine wagonloads of "stone coal" to the Philadelphia area but was able to sell only two of them. One of the purchasers was White & Hazard, predecessor of the Hazard Wire Rope Company now in Wilkes-Barre, Pa., which was the first to learn how to burn the hard-to-ignite fuel and the first to recognize its virtues for industrial heating.

Finding it difficult to obtain anthracite regularly, White & Hazard bought a tract of coal-bearing land near Mauch Chunk, Pa., on the Lehigh River in 1817 and also leased other nearby property. They got the latter for an annual rental of one ear of corn when they agreed to mine and transport 40,000 bushels of coal to their wire mill, the owners figuring that the development of transportation facilities and a market in Philadelphia would greatly increase the value of their land.

In order that they might deliver the coal via the Lehigh and Delaware rivers, White & Hazard succeeded, in 1818, in getting the Pennsylvania Legislature to authorize work on the Lehigh to improve navigation. Others had tried unsuccessfully to do this, but the two partners, with the help of a man named Hauto, tackled the project undismayed. They built a 9-mile road from the mine to the river, and in 1827, when rails were laid, it became the country's first steam railway.

They deepened the river by blasting its rocky bottom, and when unusually low water grounded the boats, they created a series of connected pools by constructing crib dams and fitting them with locks. Chains of boats, built from timber cut near the mine, carried the coal to Philadelphia, where they were dismantled. The lumber was sold and the nails and other iron were returned to Mauch Chunk to be reused.

Later, to meet competition from the Schuylkill Navigation Canal, canalization of the Lehigh and Delaware was begun, and White supervised the excavation of the Lehigh branch. This waterway was opened in 1829 and connected at Easton, Pa., with the Morris Canal, which ran across New Jersey to New York Harbor. Subsequently, the Lehigh Navigation Coal Company branched out into other parts of the anthracite field and remained, for nearly a century and a half, an important factor in the hard-coal industry.

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Inco Is Chimney Champ

The tallest smokestack in the British Commonwealth is rising skyward at Copper Cliff, Canada, to serve International Nickel Company's new $16 million smelter where, for the first time, high-grade by-product iron will be recovered from nickel ores. The stack, of reinforced concrete lined with special brick, will extend 615 feet above a 22-foot-high base and weigh 17,000 tons. It will have an outside diameter of more than 63 feet at the bottom and an inside diameter of 30 feet at the top. The Empire chimney championship won't shift very far when the new structure is completed because it is already held jointly by two 500-foot stacks at another Inco Copper Cliff smelter.

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Hoover Tunnels Exceeded

Sweden's new Kilforsen 285,000-kw hydroelectric generating station, which was put into operation on May 20, has some unusual features. It utilizes a head of 324 feet that results from a series of nine rapids in the Fjallsjo River. After use, the water is discharged into another stream, the Angerman.

From a storage reservoir, created by erecting a dam at the head of the rapids, water flows through a 1.2-mile canal and then through a 2.4-mile tunnel into a second reservoir. The bore is approximately 42 feet wide and 55 feet high and its cross section of 2240 square feet is the largest opening of its kind. (The four 56-foot-diameter diversion tunnels driven at Hoover Dam in 1931-32 had a cross section of roughly 2149 feet before being lined).

It was necessary to provide means that would permit floating logs through the bore destined for sawmills or paper mills, and about five million of them will be handled annually. A traveling, motor-driven platform makes it possible to observe the sticks so as to prevent or unlock jams in the passageway. For the further transport of the logs, a small amount of water released from the second reservoir flows through a flume to the Angerman River, while the remainder is precipitated down a 324-foot vertical shaft to three Francis turbines that discharge into the Angerman by way of a 2-mile tunnel with a cross section of 1890 square feet.

The construction program involved the excavation of around 2,100,000 cubic yards of rock and an equal amount of rubble and earth. The undertaking, which was in charge of the State Power Board, cost about $28 million. Work was begun in 1947. For the convenience and comfort of the workers, who numbered as high as 1100, a complete town with such facilities as a community center, a library and hobby workshops was built in the remote area. Some constructed their own homes; others lived in houses provided for them. Completion of the station marked a continuation of the trend towards increased power generation in Sweden, where one-fifth of all postwar industrial capital invested has been spent for that purpose.

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Petroleum Facts and Figures

Petroleum and natural gas supplied less than one-third of the nation's energy needs 25 years ago, but by 1953 the proportion had mounted to two-thirds. America accounts for 62 percent of the free world's consumption of crude oil, and its products and per capita use of them is twenty times that of the remainder of the population involved.

At the beginning of 1954 we had 501,-859 producing oil and gas wells scattered over 28 states. The average 42-gallon barrel of petroleum yields 18.9 gallons of gasoline, 8.7 gallons of light fuel oil, 7.4 gallons of heavy fuel oil, 2.1 gallons of kerosene, 0.9 gallon of lubricating oil and 4 gallons of miscellaneous substances such as coke, asphalt and waxes. The greatest concentration of oil refineries is on the Gulf Coast. Those in the strip extending from New Orleans, La., to Brownsville, Tex., have a combined refining capacity of 2,547,000 barrels per day, which is one-third of the country's total. They cost upwards of a billion dollars, and during the next two years $200 million will be spent in expanding them.

It is believed that the first drive-in automobile service station was opened in 1905 at the plant of the Automobile Gasoline Company in St. Louis, Mo. The American Petroleum Institute claims that there are so many stations now that a motorist could drive from New York to Los Angeles over the main highways with a gasoline tank holding only one gallon. He would always be able to reach another "gas" pump before the tank was empty.

Industrial Notes

For production-line use, Senco Products, Inc., has announced a line of staplers for light- and heavy-duty service in manufacturing furniture, in upholstering, in applying automotive trim and for other purposes especially with pressed and hardwood where extra holding power is required. Of light weight to lessen fatigue, the units are actuated by a trigger and can be held in any convenient position. (The one pictured is shown with the operating mechanism horizontal and the magazine vertical.) Compressed air serves to draw the anvil into tacking position and to drive and clinch staples ranging in length from 5/32 to 1/2 inch and having narrow and wide crowns. The force of the clinch may be varied by regulating the air pressure.

Circle 1E on reply card

Maintenance men of electric utilities, etc., will have no trouble locating buried conduits, tanks and the like if Filtration Equipment Corporation's aluminum divining rod does all that is claimed for it. Called Findzit, it consists of two rods that are held parallel to the ground as the operator walks along. Upon approaching the object of his search the rods begin to swing outward, and by the time he is directly over it they are as far apart as they will go. The device is also said to be a depth detector. For that purpose the user holds the two rods close together while standing on the spot beneath which the pipe or tank lies and backs away. Depth is determined from the distance between the two outer points when rods stop moving laterally.

Circle 2E on reply card

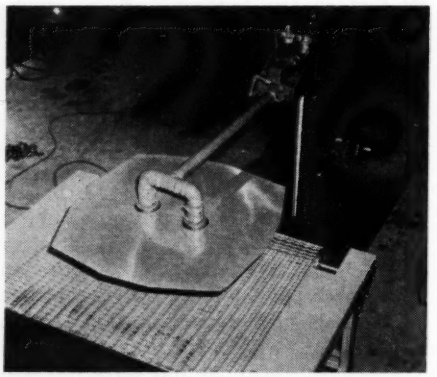
A new type of joint for vitrified clay pipe from 8 to 36 inches in diameter has been announced by the Clay Sewer Pipe Association, Inc. Called Pressure Joint, it consists of a hollow rubber gasket much like an automobile inner tube. It is slipped around a pipe's spigot end, which is then inserted into the bell of the adjoining length. Extending from the gasket is a short filler sleeve through which a grout mixture is forced into the gasket until it is uniformly expanded under a pressure of 50-60 psi. A metal collar crimped over the sleeve seals it, and the grout sets to form a tight joint.

Circle 3E on reply card

Seizing and galling of threaded fasteners exposed for protracted periods to temperatures up to 1200°F is prevented, it is claimed, by Thred-Gard, a non-hardening compound offered by Crane Packing Company.

Circle 4E on reply card

To facilitate the handling of steel sheets measuring up to 40x40 inches, The Union Tool Corporation has designed an automatic vacuum lift that is ready for service when connected to air and electric lines. It has a built-in vacuum system controlled by push button and not only picks up the sheets but also places them neatly on pallets,



conveyors or machines for processing. The unit has a lifting range of 36 inches, and the 4-foot arm to which the large-area vacuum plate is attached swings through an arc of 180°. Both lateral movement and height are adjustable within the given limits. The lift is said to handle from one to six sheets per minute and consumes approximately 0.6 cf of air per cycle.

Circle 5E on reply card

Disruption of pneumatic process or control systems is prevented, it is said, by use of an automatic shut-off valve designed by Builders-Providence, Inc. The unit embodies a spring-loaded diaphragm which, under normal conditions, is balanced by line pressure on one side and system pressure on the other. If this balance is disturbed by a drop in pressure or failure of the air supply, the diaphragm closes a needle valve and locks the control valves or devices.

Circle 6E on reply card

Better than normal thermocouple protection is provided by a metal-ceramic well announced by The Bristol Company. It is said to combine the thermal conductivity and shock resistance of metal with the oxidation and deformation resistance of ceramics and, because of a wall thickness of only 1/8 inch, drastically reduces time lags in temperature response. The LT-1 tube is available in lengths of 12, 18 and 24 inches, as well as in complete thermocouple assemblies.

Circle 7E on reply card

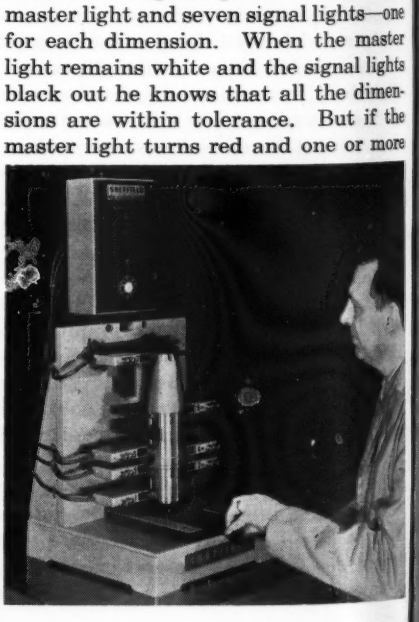
By use of Zero-Mist, Udylite Corporation claims that chromium-plating operations can be conducted without the usual chromium-acid spray that wastes the solution and contaminates the air. Additive is said to be stable and not affected by concentrated chromium-acid bath at any temperature and by high-current densities. It eliminates the need of water-wash systems.

Circle 8E on reply card

For applications where extremely fine particles in air are to be reclaimed in a dry state, American Filter Company, Inc., has designed a collector that is cleaned continually with air under pressure. Entrained solids in the process air are prevented from clogging the cloth filtering tubes by forcing high-pressure air through them in the opposite direction to the flow from which the dust is to be removed before it is exhausted to atmosphere or into the working space.

Circle 9E on reply card

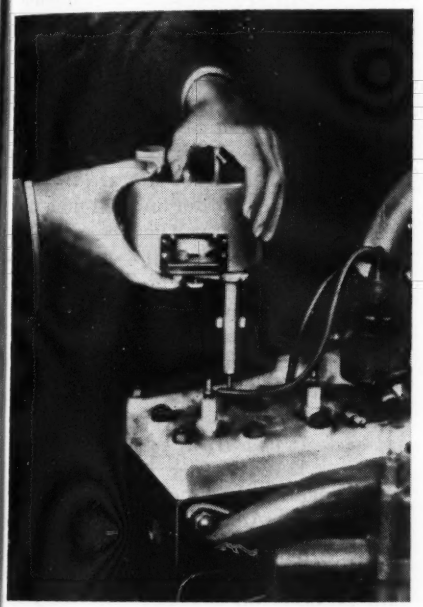
Simultaneously inspecting seven critical dimensions on shell and similar bodies is easy with this Multichek, an electrical multiple gauging instrument made by The Sheffield Corporation. All the operator has to do is place the part on a loading platform, slide it into position, and look at a diagram panel with a white master light and seven signal lights—one for each dimension. When the master light remains white and the signal lights black out he knows that all the dimensions are within tolerance. But if the master light turns red and one or more



of the signal lights glow red or green (indicating under- and oversize, respectively) he can tell at a glance which dimension or dimensions are faulty. As before, blacked-out signal lights denote correct dimensions.

Circle 10E on reply card

Askania Works, represented in the United States by Epic Inc., has announced a new hand Vibrograph, a compact instrument in a leather carrying case that is said to simplify the work of measuring mechanical vibrations destructive to machinery, shafts, cables, springs, vehicles, aircraft, ships, etc. Operated by its own clockwork, it has a built-in 6-volt, dry-cell battery that supplies a time marker with current. Interchangeable feeler rods, that may be extended to reach inaccessible places, make measurements by contact, and legible records are cut by a stylus on trans-



parent wax-coated paper tape. Two other attachments are available: one for measuring torsional vibrations, which is applied to the shaft of a motor, gears or spindle to be checked; and the other, which is mounted like a pressure gauge, for registering pressure vibrations in boilers and pumps and in lines conveying liquids or gases. The unit is designed for frequencies from 0 to 250 cps, accelerations up to 50 g and has an amplitude range from 0.00001 to ⅜ inch.

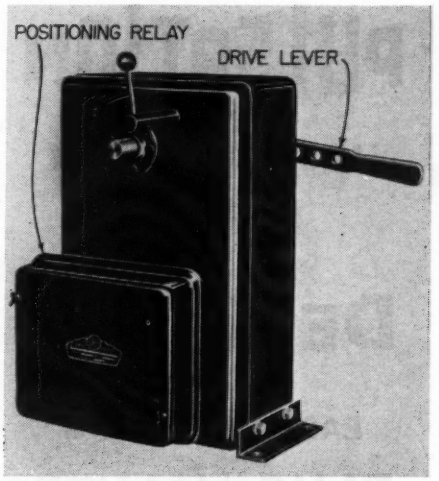
Circle 11E on reply card

If a farmer has a surplus of wheat he may soon have a market for it as a building material. Like breakfast food, the whole kernels are puffed, for this purpose to twenty times their original size, and mixed with resins, to serve as a binder, and weather-, fungi- and insect-resistant chemicals. When compacted under heat and pressure, the mass is converted into a product suitable for use as wallboard, door paneling, etc. The material is still in the experimental stage but is said to be exceptionally strong and low in cost. It was developed by Reed Research, Inc., Washington, D. C.

Kerodex, a medically tested hand cream that is said to provide maximum protection against many skin hazards, is available for the first time to American workers. It is an improved formula of the cream originally developed under British Government auspices in World War II to combat labor absenteeism caused by skin diseases. Different preparations are available for use in wet and dry work, against the irritating action of natural or artificial light rays, the photosensitizing action of tar, pitch and asphalt fumes, etc. It may be applied with safety to any area of the skin.

Circle 12E on reply card

By use of a small, air-powered control drive newly designed by Bailey Meter Company, gas and liquid-flow regulation of butterfly valves, dampers, feeders, etc., in process plants can, it is claimed, be markedly improved. The unit operates on a straight-line flow characteristic and on standard SAMA signal ranges of 3-15 and 3-27 psig. The signal actuates a relay which, in turn, positions a lever arm powered by a piston with a 4-inch stroke at a torque of 75 foot-pounds. Time required for the full travel



of 75° is adjustable. The control drive measures 10x11x19 inches and can be installed in any position on a pipe, column or any other flat surface.

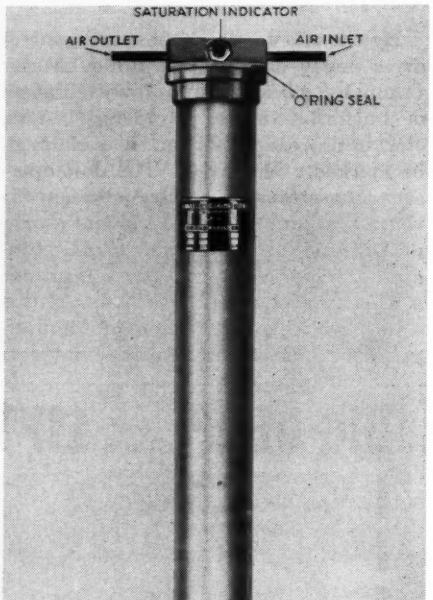
Circle 13E on reply card

Easy-to-install insulation for hot or cold pipe-line fittings is a new product of Owens-Corning Fiberglas Corporation. It is molded in half sections of Fiberglas in conformity with standard cast-iron fittings for ½- to 8-inch pipe and butt-welded long-radius fittings for 2- to 8-inch pipe. Certain sizes are available for gate and glove valves. The exterior surface of the insulation is

smooth and may be painted or covered with canvas, mastic or cement and the halves may be taped, stapled or wired together for temporary or permanent installation.

Circle 14E on reply card

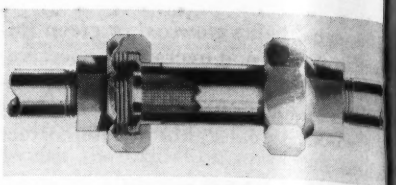
Among Hankison Corporation's latest products is a new model Dehydrafilter, the CM-1, a small unit designed especially for isolated pneumatic equipment such as liquid-level indicators, louvre and damper operators and single-valve installations in dead-end and low-flow service. It consists of a head and case holding a cartridge filled with variable dessicants, depending on requirements. Compressed air or other gas from the source of supply, which may enter either at the top-right or left, flows down an annular space between the case



and the cartridge, up through the filtering medium and out at a point opposite the inlet. But before the dry air is discharged, it passes through a visual saturation indicator which turns from blue to pink when the cartridge has to be reactivated in an ordinary oven. No tools are needed to effect replacement because of the unit's O-ring seal construction. The CM-1 is rated at 1 scfm at 100 psig and 70°F and is said to assure dew points as low as minus 67°F.

Circle 15E on reply card

The straight-line strainer shown in the accompanying illustration is designed to supply an uninterrupted flow of clean water, air or other gases for the protection of equipment, appliances, valves and controls. Of noncorrosive construction throughout, it has a large straining area and is provided with union couplings to facilitate installation and removal for servicing. A product of Industrial Sales



Division of Hays Manufacturing Company it is known as Straitflo and is said to reduce friction, turbulence and loss to a minimum. It is available in pipe sizes ranging from ¼ through 1 inch.

Circle 16E on reply card

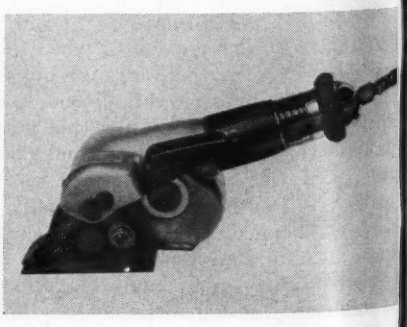
Improvements in its self-sticking pipe markers have been announced by W. H. Brady Company. They are said to have twice the adhesive properties of the earlier type and to stick tight at temperatures from minus 300 to plus 300°F, continuous, and of 450°, intermittent. More than 1000 different markers are carried in stock and special ones are made to order. Samples are available.

Circle 17E on reply card

Lightweight, high-strength titanium bolts have been developed by Standard Pressed Steel Company after two years of research. Though intended primarily for the construction of aircraft, they can be produced to order in well-nigh any design and size for the chemical and other industries, especially where resistance to corrosion is a factor. Six types are available: two lines of flush-head shear bolts, two of internal-wrenching tension bolts, and one each of external hexagon shear bolts and external-wrenching tension bolts.

Circle 18E on reply card

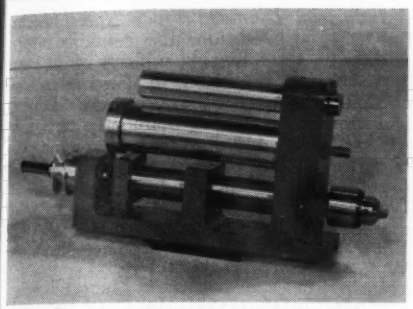
By means of a pneumatic hand tool designed by Acme Steel Company, the work of strapping narrow or wide, flat or round bundles, packages or objects can be done on a production-line basis without physical effort on the part of the operator. Designated as a friction-type stretcher, it is actuated by a throttle and applies steel strip, inserted into it, at uniform tension set by an adjustable air-pressure regulator, any amount of slack being taken up by rotary gripping dogs. Tools are available in weights ranging from 3½ to 9½ pounds, the one pictured being a 7½-pound model for use where operating surfaces are limited. It is suitable for strapping irreg-



ularly shaped products such as transformer cores, metal bars and strip material and even automotive parts on skids and building stones on pallets. Ends are sealed and crimped by a special plierlike tool.

Circle 19E on reply card

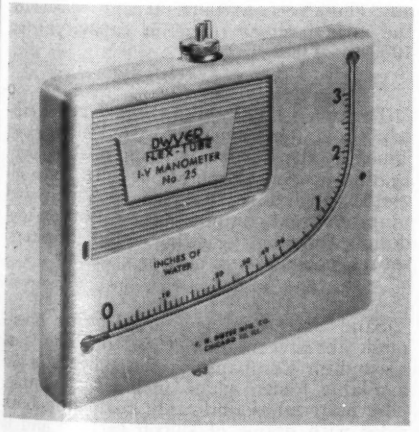
Telematic Corporation is offering an air-feed drill head with Hydro-Check control that is designed to meet industry's need for a low-cost flexible unit suitable for high-production multiple-hole drilling operations. It has an over-



all length of only 12½ inches, is 2 inches wide, has a 2-inch stroke with quick return and is powered with air at 20 to 150 psi, line pressure. Construction permits removing air-feed cylinder and Hydro-Check individually without disturbing the head or setup. Sides and bottom of the body are machined square and parallel to the spindle to simplify aligning drill. The unit is available mounted on a T-base with an automatic air-control box and cycle timer.

Circle 20E on reply card

What is described as an unusually adaptable gauge for plus, minus and differential readings has been announced by the F. W. Dwyer Manufacturing Company. Designated as the I-V, it is said to serve as an air-velocity meter, draft gauge, static-pressure indicator, air-filter gauge, etc. Equipped with a plunger-type oil-level adjuster, it is avail-



able in ranges of 0-3 and 0-7 inches water. The new instrument is also made in a direct-reading velocity model for use with a pitot tube and in ranges of 0-7000 and 0-10,500 feet per minute.

Circle 21E on reply card

Books and Industrial Literature

The Smithsonian Institution has announced that the ninth revised edition of its Physical Tables is now available. Of 827 pages with index, the book includes new data on the subject of atomic physics, and its 901 tables have been prepared and arranged for easy use. Publication No. 4169 can be obtained from the Distribution Section, Editorial and Publications Division, The Smithsonian Institution, Washington 25, D.C. Price; paper cover, $9, cloth-bound, $10.00.

Industrial Diamond Trade Names Index for 1954, fifth edition, also contains information on the following subjects of interest to users and producers of diamond tools: crystallography and physical and mechanical properties of the diamond; care and use of diamond truing tools; recommendations for the use of diamond turning tools; use of glazier's diamonds; comparison of fine sieves; and British and international diamond tool standards. Publisher, N.A.G. Press Ltd., 226 Latymer Court, London W. 6, England. Price, 3s. 6d.

Catalogue No. 1748 published by Norton Company contains full information about its line of reinforced resinoid grinding wheels. The 28-page book contains many pictures of typical applications and tables of wheel sizes and operating speeds.

Circle 22E on reply card

Stoolcraft is the name of a humorous, illustrated booklet published by Standard Pressed Steel Company and dealing with its Hallowell line of industrial stools and chairs that are designed for comfortable sitting at the job to lessen fatigue.

Circle 23E on reply card

Representative examples of the wide range of custom-engineered equipment built by the Henry Vogt Machine Company for petroleum refineries, chemical plants, power stations and related industries are illustrated and described in Bulletin E-1 now available upon request.

Circle 24E on reply card

Bulletin No. 122 issued by Niagara Blower Company discusses its Type A air conditioner that is designed to control temperature and moisture with precision so that products can be made or processed under any climatic conditions at any season of the year. Units range in capacity from 1000 to 24,000 cfm.

Circle 25E on reply card

The seventh edition of the Carmet Methods Manual on cemented carbides has been issued by the Carmet Division of Allegheny Ludlum Steel Corporation. It lists all grades, including tungsten, titanium and tantalum, and contains information on tool design, brazing, grinding, chip breakers, setups, coolants and cutting speeds.

Circle 26E on reply card

Sand Screen, a new nonclogging open-mesh abrasive manufactured by The Carborundum Company, is the subject of an available folder which includes a sample. The material is uniformly coated on both sides with grains of silicon carbide and is used in sanding ferrous and nonferrous metals, wood, paint undercoats and sealers.

Circle 27E on reply card

In addition to its regular line of bronze, steel and stainless-steel seamless, flexible hose, Cobra Metal Hose Division of DK

Manufacturing Company is offering monel and nickel hose for high-temperature and high-pressure use under extremely corrosive conditions. All are illustrated and described in Catalogue No. 100, which also lists applications and specifications.

Circle 28E on reply card

Morse Chain Company offers an illustrated Catalogue, C14-54, describing its torque limiters—compact, adjustable slip-clutch devices that provide automatic overload protection for machinery drives. Design and operating information is included in addition to specification tables for eleven standard models with torque capacities from 20 to 620 foot-pounds.

Circle 29E on reply card

Bondolite, a high-strength structural material made by Goodyear Aircraft Corporation, is described and illustrated in a folder or 32-page brochure, either of which is obtainable upon request. Originally developed for the aircraft industry, the material has many applications in other fields where toughness and lightness are essential and may be used for decorative purposes.

Circle 30E on reply card

An Approach to Solvent Safety is the title of an address recently made by John B. Moore, president and technical director of John B. Moore Corporation, in which he sets forth seven rules to be followed in selecting solvents for given applications. Though directed to safety engineers of the electric-power industry, the talk is basic to all industries. It has been reprinted for distribution.

Circle 31E on reply card

Air and hydraulically operated plug-valve actuators are discussed in Bulletin 3020 being distributed by Ledeen Manufacturing Company. In addition to typical applications with line drawings and selection tables, the 8-page brochure describes tandem-type actuators for valves that need relatively high operating torques and a new floating-bar type for valves that require lower torques.

Circle 32E on reply card

John A. Roebling's Sons Corporation is distributing a publication that makes it easy for a buyer of wire rope to select what he needs and to order it by code number. Called *Wire Rope Recommendations and Catalog*, it is divided into sixteen sections marked by index tabs for quick reference. Each deals with one of the major industries that use wire rope and gives full data about the product designed for it.

Circle 33E on reply card

A folder on its new line of conveyor belts for food handling or light industrial uses has been published by the Industrial Products Division of The B. F. Goodrich Company. It features both the company's Koroseal belt, resistant to 50° to 150°F and to oils, mild acids, alkaline or neutral salts, and the Kleenseal and Highseal rubber conveyors for applications where temperatures do not exceed 212°F.

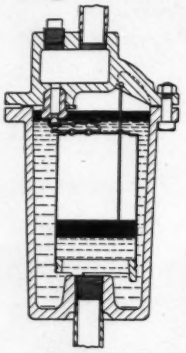
Circle 34E on reply card

Form 4153 recently released by Ingersoll-Rand Company deals with its new QM-2 Quarrymaster, a large blasthole drill that can be adapted for either rotary or percussion drilling. Features and applications of both are described, and a double-page spread shows the structural components with explanatory text. The 15-page bulletin contains numerous pictures of Quarrymasters at work on different jobs.

Circle 35E on reply card

THIS AIR TRAP
is not stopped by oil

NOW you can get dependable, automatic drainage of water from compressed air intercoolers, aftercoolers, receivers and separators even though the compressor is pumping heavy oil. Any oil reaching Armstrong Inverted Bucket Air Traps collects at the top and is discharged ahead of the water.



Inverted Bucket Air Traps.
Side-inlet side-outlet styles available.

Armstrong Air Traps have a simple, proven design; there's nothing to stick, bind or clog. Stainless steel mechanism resists corrosion. For pressures to 600 lbs. *Guaranteed to Satisfy.*

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SHEAVES • FLAT BELT PULLEYS • HANGERS
PILLOW BLOCKS • COUPLINGS • BEARINGS
COLLARS • "SURE-GRIP" SHEAVES AND PULLEYS • "SURE-GRIP" STANDARD, SUPER AND STEEL CABLE V-BELTS • COMPLETE DRIVES
VARIABLE SPEED DRIVES

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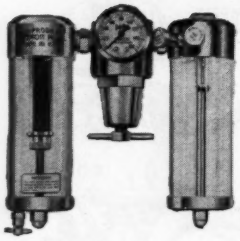
Circle 20A on reply card

Prominent User Acclaims

"M-B" Automatic Air Line FILTER, REGULATOR and LUBRICATOR Assembly



The value of "M-B" Automatic Air Line Filters, Regulators and Lubricators is widely known for their effectiveness as a protection to Air Valves, Cylinders, Pneumatic Tools, etc.

"Your 'Sentinel of the Air Line' has been giving us very good service. We have had no complaints at all and I trust that we will be ordering more of them in the near future."

signed: **A. E. Cranston, Sr.**
PRESIDENT

Cranston Steel Strapping Co.
Oak Grove, Oregon

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Circle 21A on reply card

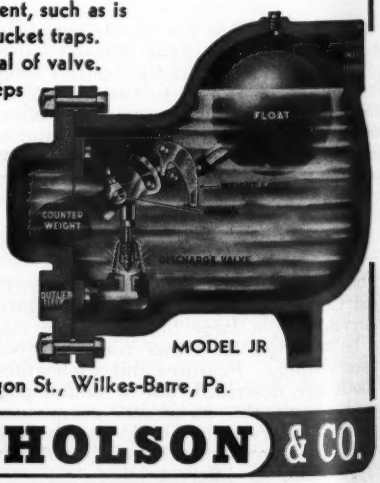
Solve Sludge Problem with Nicholson's

New AIR TRAPS

With the introduction of an exclusive new oil-eliminating feature that prevents build-up of scum and sludge, Nicholson air traps now enable you to enjoy the advantages of the positive intermittent action of a float-operated air trap without the common problem of oil congealing on the mechanism and impeding or stopping its action. Other features of Nicholson air traps:

1) No air-wasting vent, such as is in all inverted bucket traps.
2) Positive water seal of valve.
3) Large orifice keeps valve clean, preventing blow-through. Three types, pressures to 1500 lbs. For details send for

CATALOG 953



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